Whitsunday Regional Council Development Manual

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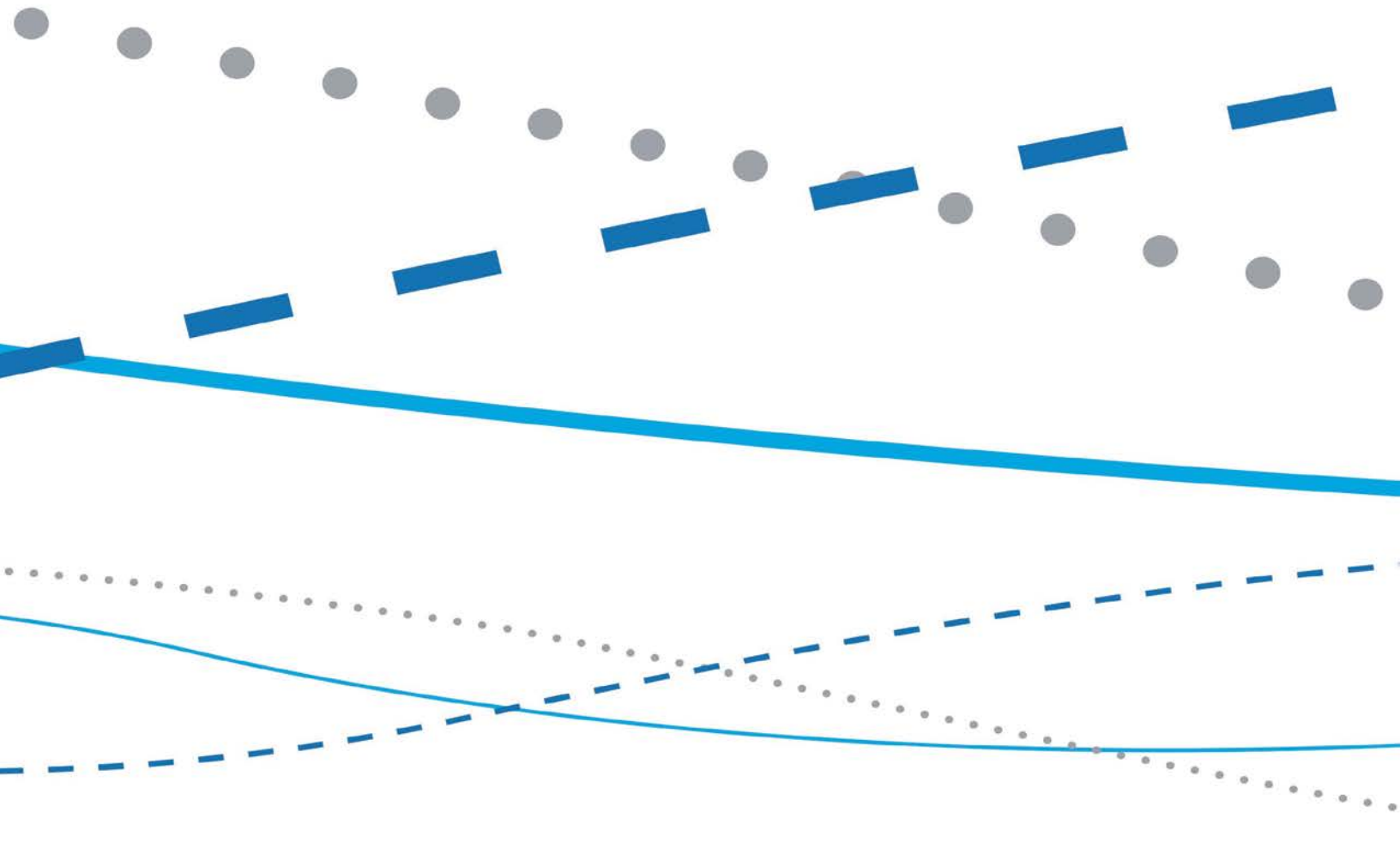
This document is the property of Whitsunday Regional Council and is issued to developers, consultants, contractors and Council officers responsible for the development process from inception to completion.

No unauthorised changes are to be made to this manual. Suggested changes are to be forwarded to the Manager Strategic Planning for consideration.



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Definitions and Acronyms

AASHTO	American Association of State Highway & Transportation Officials
AC	Asphaltic Concrete
ADWF	Average Dry Weather Flows
AHD	Australian Height Datum
AMCORD	Australian Model Code for Residential Development
ARI	Average Recurrence Interval
AEP	Annual Exceedance probability
ASD	Approach Sight Distances
ASS	Acid Sulphate Soils
AV	As Values
BBQ	Barbecue
CBR	California Bearing Ratio
Consulting Engineer	An RPEQ certified engineer
CPESC	Certified Professional in Erosion and Sediment Control
CPTED	Crime Prevention through Environmental Design
Days	Business days
Defects Liability	Means the obligation upon the developer/applicant to repair any defects (latent or patent) in the development.
Defects Liability Period	Means the period commencing on the date stated in Council's Defects Liability Letter and ending on the date stated in that letter. For the avoidance of doubt, Council may impose a different period for defects liability and 'on maintenance' periods.
DICL	Ductile Iron Cement Lined
DTMR	Department of Transport and Main Roads
EP	Equivalent Persons
ESA	Equivalent Standard Axles
ESC	Erosion and Sediment Control
ESCP	Erosion and Sediment Control Plan
ESCS	Erosion and Sediment Control Strategy

ESD	Entering Site Distance
FRC	Fibre Reinforced Pipe
HDPE	High Density Polyethylene
IDF	Intensity Frequency Duration
IEAust	Institute of Engineering Australia
IPWEA	Institute of Public Works Engineering Australia
ITP	Inspection and Test Plan
K	Potassium
LATM	Local Area Traffic Management
MUTCD	Manual of Uniform Traffic Control Devices
N	Nitrogen
NATA	National Association of Testing Authorities
Off Maintenance	Means that the ownership and the maintenance obligations have transferred to Council upon completion of the “Off Maintenance” inspection occurring at the end of the “On Maintenance” period.
On Maintenance	Means that ownership of the asset has passed to Council but the maintenance responsibility and obligation remains with the developer/applicant for the On Maintenance Period. Maintenance includes but is not limited to mowing, whippersnipping, watering, cleaning and general upkeep, as well as the rectification of any defects and shall be at the sole cost of the developer (unless caused by Council activities).
On Maintenance Period	Means the period of time commencing on the date of issue of the “On Maintenance “letter from Council and ending on the date stated in that letter.
P	Phosphorus
PASS	Possible Acid Sulphate Soils
PE	Polyethylene
PVC-M	PVC modified
QLD	Queensland
QUDM	Queensland Urban Drainage Manual
RM	Rising Main
RPEQ	Registered Professional Engineer Queensland

RPZD	Reduced Pressure Zone Device
SCADA	Supervisory Control and Data Acquisition
SISD	Safe Intersection Site Distance
SQID	Stormwater Quality Improvement Devices
Surveyor	Registered Surveyor with the Surveyor's Board of Queensland
SV	Scour Valves
U PVC	Unplasticised PVC
Vpd	Vehicles per day
Wet Sediment Basin	A wet sediment basin has the capacity to contain all run-off expected from the y percentile, X – day rainfall depth where, depending on the sensitivity of the receiving waters and/or the duration that the structure is in use: x varies between 2 and 20 days and y varies between 75th and 90th percentile. Refer to IECA best practice erosion and sediment control.

A1 – APPLICATION PROCEDURES

General

AP 1.01 Introduction

1.01.1 This manual sets out procedures involved in applying for an Operational Works permit for works that will ultimately be in the ownership and maintenance responsibility of Council or other service authorities or works which are subject to approval by Council;

1.01.2 It should be read in conjunction with the relevant approvals and/or what development permit conditions;

1.01.3 Conditions of a development permit (including reconfiguration) may require the Applicant to construct, bond and/or submit, various works or documentation before survey plans can be approved and sealed by Local Authority or before a development may be occupied or a land-use commenced;

1.01.4 Preliminary approvals/development permits requiring the construction of operational works generally involve the applicant and/or a designer applying for an operational works permit and request in Council approval of designs and specifications;

1.01.5 Plans for roadworks, drainage works, water supply, sewerage works, bridges, retaining walls, miscellaneous structures, buildings, pumping stations and flood control structures are to be prepared under the direction of and certified by an RPEQ;

1.01.6 plans for landscape works by a person of professional standing and competence in the field of landscape architecture or landscape design, and a standard acceptable to the Council. Where irrigation plans are required for public parks, traffic islands or roundabouts, they are to be prepared by an irrigation designer with a proven track record of successful irrigation design;

1.01.7 designs, calculations, drawings and specifications are to be submitted as supporting information to an application for a Development Permit for Operational Works;

1.01.8 Operational Works permits will not be issued until evidence of payment of the Portable Long Service Leave and Occupational Health & Safety fees is provided.

Design Approval

AP 1.02 Pre-lodgement discussions

1.02.1 Prior to lodgement of an Operational Works application for approval of detailed designs, the designer is encouraged to meet with Council officers to discuss the

following matters in the event that the following issues have not been addressed at reconfiguration of a lot approval:

1.02.1.1 Legal points of stormwater discharge;
1.02.1.2 Identify environmentally significant areas and heritage features;
1.02.1.3 Internal and external stormwater catchment boundaries;
1.02.1.4 Tail water conditions including water quality requirements and determination of tail water level;
1.02.1.5 Connection points for water supply and available pressure and discharge capacities;
1.02.1.6 Discharge points for sewerage;
1.02.1.7 setback distances from watercourses for on-site wastewater treatment and disposal;
1.02.1.8 future planning for the provision of services, e.g., water supply, sewerage, drainage and road networks, stream management and stormwater quality management, structures, power, communications and gas. In special circumstances, the Council may require the installation of large water mains to serve areas beyond the development;
1.02.1.9 Site Conditions;
1.02.1.10 Development Permit Conditions for the for the particular development;
1.02.1.11 layout design, speed restriction; and
1.02.1.12 landscaping works for on street works and public open space.

1.02.2 Approval of designs can be expedited where the above issues have been resolved in advance;

1.02.3 The designer may obtain as constructed information in relation to existing roads, stormwater drainage, water and sewer reticulation if available from Council, on application and payment of a prescribed fee (where applicable);

1.02.4 in addition to the above, it is advisable that the designer discuss and obtain Council's agreement to the following issues (where required) prior to submission of designs:

1.02.4.1 Possible variation to Council's manual and standards;
1.02.4.2 Variations to design due to inability to obtain drainage discharge approvals; and
1.02.4.3 Request for Council to contribute towards some aspects of the work.

1.02.5 Resolution of these issues, particularly those requiring a decision of Council (i.e. amendments to conditions of approval, or request for Council contributions) is essential to avoid protracted approval periods and wasted design effort.

AP 1.03 Design Requirements

1.03.1 The design of operational works must comply with the relevant development permit conditions, Council's local laws, policies, planning scheme and the provisions of

this manual. The developer shall meet all costs associated with the compliance with these minimum requirements.

1.03.2 Design is to demonstrate a non-worsening affect to surrounding infrastructure, where upgrades are required the developer must bear the all costs associated with the required upgrade.

1.03.3 It is Council's requirement that the design of all operational works must be prepared under the direction of, and certified by, an RPEQ. The RPEQ must bear full responsibility for all aspects of the design of the operational works, which they certify.

1.03.4 Road safety audit to be undertaken by a suitably experienced RPEQ as per the requirements and Austroad's Guide to Road Safety to verify designs and signage prior to submission to Council.

AP 1.04 Consent of Adjoining Landowners

1.04.1 Written approval is required from adjoining property owners authorising any operational works on their property (if under an easement authorisation must come from the easement owners).

1.04.2 Approvals to discharge and/or easements over downstream drainage paths from the respective property owners are required from the development site to the approved point of discharge.

AP1.05 Documentation

1.05.1 Associated with the lodgement of the "Application for Operational Works Development Permit", engineering plans and specifications for the works are to be submitted to Council for approval (the specific requirements for the submission).

1.05.2 Submissions with a full complement of supporting documentation will ensure minimal delays in Council's approval timeframes.

1.05.3 Following the issue of an operational works permit, any plans that are required to be amended must be resubmitted with an accompanying letter outlining the amendments and including any necessary calculations or documentation as supporting information.

1.05.4 One complete description must be issued to Council incorporating any required amendments following the issue of an operational works permit.

AP 1.06 Local Authority Approval

1.06.1 The "Statement of Compliance – Operational Works Design" (refer Form 1) has been introduced to expedite the approval process.

1.06.2 Any non-compliant aspects are to be re-designed by the certifying RPEQ and relodged to Council for approval.

1.06.3 If the Council review reveals the Statement of Compliance to be inaccurate or incomplete, the submission may be returned to the applicant for resubmission.

1.06.4 It is the RPEQ's responsibility to ensure the design as submitted considers all site conditions and complies with Council's approval conditions, local laws, policies, the provisions of this Development Manual and other relevant authorities.

1.06.5 Council's review and stamp approval process does not warrant that an approved design complies with the above in every respect, and Council reserves its right to order the rectification of non-complying or unsafe works at the cost of the developer, despite its prior approval.

1.06.6 Within five (5) days of Council's approval, the designer shall submit an electronic copy of the requirements of 1.08 below.

1.06.7 Three (3) street names for each new street (in line with any Council naming policy) must be lodged for consideration and approved by Council before construction is complete.

AP 1.07 Approval of Other Authorities and Referral Agencies

1.07.1 The applicant is responsible for gaining the approvals of any other authorities having jurisdiction over any part of the works.

1.07.2 All works on state-controlled roads will be subject to DTMR approval and is to be carried out in accordance with the Department's policies, standards and guides.

1.07.3 All referral agency conditions are to be included in design documents and must be approved by each agency (if required), prior to submission to Council.

AP 1.08 Supporting Information

General

1.08.1 Supporting information for operational works shall include the following:

- 1.08.1.1 Design Plans (in DWG and PDF Format)
- 1.08.1.2 Job specification (one copy)
- 1.08.1.3 Design report (one copy)
- 1.08.1.4 Design checklist
- 1.08.1.5 DA form 1 and/or relevant application forms from the *Planning Act 2016*
- 1.08.1.6 Evidence that the prescribed application fee as stated in Council's fees and charges schedule, has been paid.
- 1.08.1.7 Evidence of payment of the Portable Long Service Leave Levy and Occupational Health & Safety fee.
- 1.08.1.8 'Permit to Enter & Construct' letters and easement documents relevant to the application.

Design Plans

1.08.2 Design plans shall be definitive and clearly set out to present the design concepts in such a way that the project can be understood, specified for construction and satisfactorily built, generally in accordance with AS1100.101.

1.08.3 All design plans should be clearly numbered with separate sheets numbered as part of a set.

1.08.4 Sheets of drawings should not be overcrowded with information and should not rely on colour printing or colour wash to impart information. Drawing should be true to scale A1 size sheets and be suitable for black and white copying and photo reduction.

1.08.5 Design plans must be certified by an RPEQ (refer 1.03.2).

Job Specification

1.08.6 A job specification must be prepared by the designer specifying site-specific requirements not covered in standard specifications.

1.08.7 All work shall be in accordance with Council standard specifications where available. Where Council standard specifications exist for a particular type of work, the designer may use the Department of Transport and Main Road specification or their own standard specification. Both options will be subject to approval by Council.

Design Report

1.08.8 The engineering design and materials used must be selected to minimise the whole of life Cost to Council. The designer must demonstrate how the design complies with this requirement.

1.08.9 The design report is to contain the following:

- 1.08.9.1 a completed 'Statement of Compliance – Operational Works Design' endorsed by the designers.
- 1.08.9.2 A copy of the development approval conditions on which the design is based including a summary of the design submission referencing each of the development approval conditions.
- 1.08.9.3 Records of pre-submission discussions with Council including confirming correspondence.
- 1.08.9.4 Copies of letters of approval from adjoining property owners for any works or discharge on the properties.
- 1.08.9.5 Evidence that negotiations have been entered into regarding provision of supply with service authorities (including approved reticulation/service plans, if available).
- 1.08.9.6 Stormwater drainage calculations in spreadsheet format in accordance with QUDM requirements including detail of pit types and capture charts used and tell water levels adopted.
- 1.08.9.7 Design details of alternatives proposed which depart from the development manual/development conditions with supporting arguments for how the alternative meets Council's objectives.
- 1.08.9.8 Design calculations for detention basins, dissipated as, open channel, catch strain, adopted tail water levels etc.

1.08.9.9 design criteria and parameters operating regimes and calculations for permanent water quality works such as stormwater quality improvement devices (SQIDs), sediment basins, trash racks, etc and demonstrated consistency with catchment Stormwater Quality Management Plan and water quality report which accompanies the development application.

1.08.9.10 An Erosion and Sediment Control Strategy (ESCS) addressing erosion and sediment management during construction.

1.08.9.11 Traffic Management Plan in accordance with the MUTCD.

1.08.9.12 Water and sewerage reticulation networks in a format compatible with Council's network system.

1.08.9.13 If the water supply is from a newly developed source, provide information on quality, quantity, disinfection and infrastructure proposed.

1.08.9.14 Pavement design including records of geotechnical tests indicating subgrade CBR's, adopted traffic load, requirements for subsoil drainage and subsoil drainage design by geotechnical engineer.

1.08.9.15 Geotechnical reports, where relevant, relating to slope and batter stability, in situ materials etc.

1.08.9.16 Structural and geotechnical certification of design of miscellaneous structures including retaining walls, non-standard headwalls, drainage structures, reservoirs etc.

1.08.9.17 design parameters and operating regimes for water supply and sewerage pump stations.

1.08.9.18 Full design drawings and pre-commissioning plan for water and sewerage pump stations.

1.08.9.19 Landscaping design drawings for subdivision works showing details of Park/reserve planting, Street treeplanting, buffer zone planting, and any hill slope development works if applicable.

1.08.9.20 Four stage development, master plans showing the overall design concept for:

1.08.9.20.1 Water including pump stations.
1.08.9.20.2 Sewer including pump stations.
1.08.9.20.3 Stormwater.
1.08.9.20.4 Road works.
1.08.9.20.5 Earthworks.
1.08.9.20.6 Road hierarchy.
1.08.9.20.7 Pathways.
1.08.9.20.8 Public transport.
1.08.9.20.9 Lighting and other services.
1.08.9.20.10 Easements, freehold lots and land to be deeded to Council for accommodating the works.
1.08.9.20.11 Open space areas.
1.08.9.20.12 Erosion and sediment control strategy and location of permanent survey marks.

1.08.9.21 With stage I development and with updated copies to be provided with each subsequent stage. Subsequent development plans will show the "as constructed" information of all the earlier stages.

1.08.9.22 Selection of materials and components to be transferred to Council ownership must comply with service standards specified by Council (e.g. minimised whole of life Costa, reliability etc).

1.08.9.23 A fully priced estimate of construction costs in the form of a priced schedule of quantities.

AP 1.09 General Requirements

Plan Presentation

1.09.1 These presentation minimum standards will apply to engineering and landscape plans submitted for approval for operational works associated with approved developments.

1.09.2 Standardisation of the presentation of operational Works plans submitted for approval is necessary for consistency in Council's records and desirable for expedient review and approval.

1.09.3 Scaled engineering drawings in accordance with this manual are required for plan review.

AP 1.10 Title Block

1.10.1 Each sheet of the design drawings shall have a title block containing the following information:

- 1.10.1.1 Development/estate name (if any)
- 1.10.1.2 Locality/approved street name.
- 1.10.1.3 Developers name.
- 1.10.1.4 Bar scales as a minimum (alternatively numerical scale with original sheets I stated).
- 1.10.1.5 Plan number and sheet number.
- 1.10.1.6 Schedule and date of amendments.
- 1.10.1.7 Certification by RPEQ (for engineering drawings).

AP 1.11 Sheet Sizes

1.11.1 Preferred sheet sizes (overall dimensions) are A1 (841mm x 593mm) and A3 (420mm x 297mm).

AP 1.12 Scales

1.12.1 scales used for plan should preferably be those recommended by the standards Association. Generally, the following scale should be used 1:1, 1:2, 1:5 in multiples of 10 of these. All scales should be bar scales.

1.12.2 The following scales are also acceptable:

Description	Urban	Rural
Plans	1:500*	1:1000
Longitudinal Section:		
Horizontal	1:500	1:1000
Vertical	1:50	1:100
Intersection Details	1:100, 1:200	1:500
Cross Sections	1:100	1:100
Engineering Details	1:1, 1:2, 1:5 and multiples of 10 of these scales.	

*Sewerage Reticulation should be 1:500.

AP 1.13 Dimensions

Dimensioning on Plans

1.12.1 Linear dimensions on all roadworks plans will be in metres, with the exception of some detailed plans of small structures (e.g. manholes) and some standard plans (e.g. kerb and channel) which may be in millimetres.

1.12.2 Details of methods of dimensioning shall be in accordance with AS1155 – Metric Units in Construction.

Standard Cross-Section Intervals

1.12.3 Urban and rural cross sections should be provided to roads at 20 m intervals and tangent points, with further reduction to 10 m or 5 m intervals when necessary due to horizontal or vertical curvature.

Chainage and Offset Dimensions

1.12.4 Chainage and offset dimensions on plans shall be expressed to 0.01 m (0.005 may be used as the order of accuracy requires).

AP 1.14 Levels

1.14.1 All levels must be reduced to Australian Height Datum, unless otherwise approved by Council.

1.14.2 Reduced levels of benchmarks and reference pegs including Permanent Survey Marks shall be expressed to 3 decimal places i.e. 0.001m. the location of the origin of the survey must be on the plan.

1.14.3 Reduced levels of roadworks and stormwater drainage must be expressed to 3 decimal places i.e. 0.001m.

1.14.4 Reduced levels of sewerage reticulation shall be expressed to 3 decimal places i.e. 0.001m.

AP 1.15 Grades

1.15.1 Road grade must be shown as a percentage to 2 decimal places.
1.15.2 Pipe grade must be shown either as a percentage to 2 decimal places or as a gradient to one decimal place

AP 1.16 Drawings Required

Design Drawings

1.16.1 Operational Works drawings will generally consist of the following:
- 1.16.1.1 locality plan.
- 1.16.1.2 Subdivision layout/staging plan (if applicable).
- 1.16.1.3 Earthworks plan.
- 1.16.1.4 Roadworks and drainage plan.
- 1.16.1.5 Longitudinal section of each road.
- 1.16.1.6 Type cross sections for each Road.
- 1.16.1.7 Cross sections of each Road.
- 1.16.1.8 Detailed plan of each intersection and cul-de-sac.
- 1.16.1.9 Longitudinal section of each stormwater drainage line.
- 1.16.1.10 Sewerage reticulation plan, long section and pump station details.
- 1.16.1.11 Water reticulation plan and pump station plans and details.
- 1.16.1.12 Landscape plan.
- 1.16.1.13 Erosion and sediment control strategy.
- 1.16.1.14 Service provider's conduit plan, including street lighting.
- 1.16.1.15 Stormwater catchment plans/drainage calculation table.
- 1.16.1.16 Miscellaneous details.

1.16.2 The minimum requirements for each drawing a detailed in the following sections.

AP 1.17 Locality Plan

1.17.1 Locate the subdivision/development in relation to adjacent towns, major roads, major streets, etc.
1.17.2 Northpoint.
1.17.3 May be included on layout/staging plan for large jobs or roadworks and drainage plan for smaller jobs.

AP 1.18 Subdivision Layout/Staging Plan

1.18.1 For stage subdivisions, the layout plan should show the relationship of all new roads and infrastructure to each other, and to existing roads and infrastructure

adjoining the subdivision. All adjacent structures and services are to be shown also.

1.18.2 Where development is to be carried out by stages, the boundaries of proposed stages should be shown on this plan, and the stages identified by numbering.

AP 1.19 Earthworks Plan

1.19.1 The earthworks plan may be included with the roadworks and drainage plan for smaller subdivisions and shall include:

- 1.19.1.1 Legend.
- 1.19.1.2 Existing site contours and finished surface contours (spot levels should be used to complement contours)
- 1.19.1.3 limits and levels of all major allotment cut and fill – distinguished by hatching.
- 1.19.1.4 Locations of cut and fill batter relative to allotment boundaries.
- 1.19.1.5 Location and levels of retaining walls (if required).
- 1.19.1.6 Batter slopes and treatment.
- 1.19.1.7 Appropriate flood levels in accordance with Council's policies.
- 1.19.1.8 Northpoint.
- 1.19.1.9 Locations and levels of permanent survey Marks, reference stations etc used as datum for the works.
- 1.19.1.10 Vegetation including trees proposed to be removed in days to be retained.
- 1.19.1.11 The smaller subdivisions, the earthworks details may be included on the roadworks and drainage plan.

AP 1.20 Roadworks and Drainage Plan

1.20.1 The plan of each Road shall include:

- 1.20.1.1 Legend.
- 1.20.1.2 Road reserve boundaries.
- 1.20.1.3 Allotment numbers and boundaries, both existing and proposed (including existing and proposed easements).
- 1.20.1.4 Chainages, on centreline or construction line.
- 1.20.1.5 Bearings of the centreline or construction line.
- 1.20.1.6 Tangent point chainages of each curve.
- 1.20.1.7 Radius and arc, tangent length of each curve.
- 1.20.1.8 Chainage and the intersection point of Road centrelines or construction lines.
- 1.20.1.9 Kerb lines, kerb radii, and chainage of all tangent points of the kerb line.
- 1.20.1.10 Footpaths/bikeways and pram ramp locations.
- 1.20.1.11 Fencing.
- 1.20.1.12 Access where required to be constructed.
- 1.20.1.13 Edge of pavement, we know curb is to be constructed.

1.20.1.14 Dimensioned road reserve, footpath and pavement widths, where these differ from the standard cross-section.
1.20.1.15 Existing and finished surface contours, highlighting cut and fill areas.
1.20.1.16 Drain line locations, diameters (including extent of easements where required).
1.20.1.17 Drainage structures and structure number.
1.20.1.18 Subsoil drain locations.
1.20.1.19 Location of existing utilities and other existing works within the site.
1.20.1.20 Location of all service clashes including levels of services and clearance distance.
1.20.1.21 Location and levels of benchmarks and reference pegs.
1.20.1.22 Northpoint.
1.20.1.23 Line marking and signing*.
1.20.1.24 Guideposts, guardrails and other traffic control devices*.
1.20.1.25 Creek protection works and the like.
1.20.1.26 Street name signs*.
1.20.1.27 Overland drainage paths.

*may be shown on separate plan(s).

AP 1.21 Longitudinal Sections of Roads.

1.21.1 The longitudinal section of each road shall include:
1.21.1.1 Chainages.
1.21.1.2 Existing surface levels – design Road centreline levels.
1.21.1.3 Cut and fill depths.
1.21.1.4 Design grades.
1.21.1.5 Chainages and levels of grade intersection points.
1.21.1.6 Chainages and levels of tangent points of vertical curves.
1.21.1.7 Chainages and levels of crest and sag locations.
1.21.1.8 Lengths and radii of vertical curves.
1.21.1.9 Sections on control lines on superelevated curves (i.e. pavement edges, kerb or lane edges), curve widening and superelevation details.
1.21.1.10 Location of services where they cross the centre of the road.

AP 1.22 Type Cross-Sections

1.22.1 A type cross-section shall be shown for each Road, including:
1.22.1.1 Road reserve with.
1.22.1.2 Pavement widths including medians (as applicable).
1.22.1.3 Footpath widths.
1.22.1.4 Cross falls of pavement and footpath.
1.22.1.5 Pavement depth – nominal or design.

1.22.1.6 Type of kerb and channel.
1.22.1.7 Type of pavement surfacing.
1.22.1.8 Sub – soil drainage.
1.22.1.9 Table drain details for rural roads.
1.22.1.10 Batter slopes.

1.22.2 The standard cross-section may be included in the detailed cross-section is provided for each Road.

AP 1.23 Cross-Sections of Roads

1.23.1 A cross-section shall be shown at the intervals defined in this manual for each Road and shall show:
1.23.1.1 Road reserve boundaries.
1.23.1.2 Pavement centreline and/or other construction line.
1.23.1.3 Natural surface profile.
1.23.1.4 Design cross-section.
1.23.1.5 Cross full of pavement and footpath, pavement and footpath widths and pavement depths wherever these differ from the standard cross-section.
1.23.1.6 Chainage of cross-section.
1.23.1.7 Datum reduced level.

AP 1.24 Detail Plans of Intersections and Cul-De-Sacs

1.24.1 Intersection detailed plans shall include all the relevant information required for roadworks and drainage plans, as listed above together with additional details such as kerb levels on kerb returns, pavement contours, channelisation works, line marking, signing and pram ramps.

AP 1.25 Longitudinal Sections of Stormwater Drainage Lines

1.25.1 A longitudinal section of each drain line shall be shown, including:
1.25.1.1 Chainages.
1.25.1.2 Existing surface levels.
1.25.1.3 Design finished surface and invert levels.
1.25.1.4 Drainage structure chainage is and offsets and inlet and outlet invert levels.
1.25.1.5 Distances between drainage structures.
1.25.1.6 Grade of each pipe.
1.25.1.7 Material and diameter of each pipe length.
1.25.1.8 Hydraulic grade line.

1.25.1.9 Drainage structure type and sizes and/or reference to separate detailed drawing.
1.25.1.10 Crossings with any other services (location and invert level of pipe crossing).

AP 1.26 Sewer Concept Plan

1.26.1 Where development incorporates multiple stages, sewer concept plan must be prepared by the consultant.
1.26.2 This concept plan must be submitted prior to proceeding with detailed design and should include the following:
1.26.2.1 location, size, approximate depth, and alignment of gravity sewers.
1.26.2.2 Location, size and alignment of rising mains.
1.26.2.3 Location of pump stations and lift stations including justification for the use.
1.26.2.4 Contour information at 1 m intervals maximum or to suit the topography of the land for both natural surface and finished surface contours.
1.26.2.5 Contributing catchments (internal and external) showing the equivalent persons (EP).
1.26.2.6 Justification for redirecting flows between sewerage districts were proposed.
1.26.2.7 Details of the influence on downstream catchments and systems.
1.26.2.8 The flow contributing to each section of main including the estimated design capacity, e.g.:

EP300

PWWF	14.3 L/s
Pipe Size	225 diameter
Max Pipe Cap	26.2L/s

1.26.3 Access for maintenance of the system should be considered when locating manholes etc (refer section D7.07).
1.26.4 During the preparation of the concept plan consideration must be given to the integration of other infrastructure design, overall site earthworks and the impacts on existing upstream and downstream developments and potential developments.
1.26.5 As part of the preparation of the concept plan, the requirements of section 2 – concept designs in WSA 04 – 2005 Sewerage Pumping Code of Australia should also be included.

AP 1.27 Sewerage Reticulation Plan Longitudinal Section

1.27.1 The sewerage reticulation plan shall include:

1.27.1.1 Legend.
1.27.1.2 All allotments and allotment numbers.
1.27.1.3 Boundary of the subdivision.
1.27.1.4 North Point.
1.27.1.5 Location and size of existing sewers.
1.27.1.6 Invert levels of existing lines.
1.27.1.7 Location of other services which cross sewer lines.
1.27.1.8 Location of manholes with manhole numbers (including dimensions where not shown on alignment).
1.27.1.9 Identification of allotments, which are currently sewered.
1.27.1.10 Finished surface contours sufficient to enable verification of property connection design.
1.27.1.11 Details of permanent survey marks including AHD from which levels are to be transferred.
1.27.1.12 Grading information for new sewer lines including distance between manholes, pipe grades, pipe diameter, pipe material and class of each pipe length.
1.27.1.13 Manhole cover type and class.
1.27.1.14 Manhole inlet types.
1.27.1.15 Locations and level of sewer property connections and type.
1.27.1.16 Details of pumping stations including location, inlet/outlet levels, overflow, cut-off levels, electrical switchboard layout and water supply, size of pumping plant.
1.27.1.17 Diameter, material class and route of pressure main(s); indicating air valve and scour valve locations.
1.27.1.18 Clear identification of any alterations/connections to existing sewers to be completed by Council at developer's cost.
1.27.1.19 Finished surface contours with spot levels to compliment contours.
1.27.1.20 Ultimate sewer design flows including catchment plan for staged development if applicable.
1.27.1.21 Gravity sewer pipe capacities.
1.27.1.22 Structural design of pipes for pipes with more than 3m of cover.
1.27.1.23 Thrust block calculation where required.
1.27.1.24 Diagram showing all allotment controls.
1.27.1.25 Flow velocities under different flow conditions.
1.27.1.26 Rising main hydraulic grade line.
1.27.1.27 System resistance and pump curves showing static and friction head and duty points.
1.27.1.28 Demonstration of pipeline capacity to resist cyclical pressure effects over a 100-year lifespan of the systems.
1.27.1.29 Estimation of pump start, stop, alarm, overflow and other control levels.
1.27.1.30 Calculations supporting the provision of wet well storage.

1.27.1.31 Calculations showing that floatation forces are counteracted for all buried or all partially buried structures.
1.27.1.32 Estimation of electrical loads – Mains Supply proposed; and Radio Frequency interference screening measures.
1.27.1.33 Structural calculations where necessary for the pump well and associated works.
1.27.1.34 Calculations supporting the hydraulic design of emergency relief structures.

1.27.2 The longitudinal section of each sewerage line should include:
1.27.2.1 Existing surface levels.
1.27.2.2 Design finished surface.
1.27.2.3 Manhole number.
1.27.2.4 Distance between manholes.
1.27.2.5 Grade of each pipe length.
1.27.2.6 Diameter, material and class of each pipe length.
1.27.2.7 Manhole diameter and cover type.
1.27.2.8 Manhole inlet types review.
1.27.2.9 Invert levels of existing lines.
1.27.2.10 Crossings with any other services (including location, size, invert levels and clearance of pipe crossing).

AP 1.28 Water Reticulation Concept Plan

1.28.1 Where development incorporates a large number of lots with multiple stages, the consultant shall submit a water reticulation concept plan of the water reticulation showing proposed mains sizes, connections to existing mains and valve positions. The concept plan is to be supported by computer network analysis.

1.28.2 This concept plan shall be submitted prior to detailed design and should include the following:
1.28.2.1 layout of mains, together with the development layout.
1.28.2.2 Key to network analysis i.e. node points, elevation, demand.
1.28.2.3 Size and type of mains, indicated graphically and distinguished by colour and/or line type.
1.28.2.4 Design parameters – number of lots, number of EP's design flows.
1.28.2.5 Legend of land uses (i.e. residential, industrial precincts etc).
1.28.2.6 Supply points and pressure or hydraulic grade lines (HGL) as supplied by Council.
1.28.2.7 Location of pumps, pressure reducing valves and reservoir top water level (TWL) and volume where applicable.
1.28.2.8 Limit of water district serviced by the reticulation mains.
1.28.2.9 Contours for the entire development, at minimum 1 m intervals.
1.28.2.10 Consideration for connection to adjoining and/or future developments as directed.

AP 1.29 Water Reticulation Plan

1.29.1 The water reticulation plan shall include:

- 1.29.1.1 Legend.
- 1.29.1.2 The services for the development.
- 1.29.1.3 All allotments and allotment numbers.
- 1.29.1.4 Boundary of subdivision.
- 1.29.1.5 North point.
- 1.29.1.6 Location and size of existing mains.
- 1.29.1.7 Location, size, material and class of new mains.
- 1.29.1.8 Location of other services which cross the mains.
- 1.29.1.9 Details of connection to existing mains.
- 1.29.1.10 Location of each bend.
- 1.29.1.11 Location of valves, hydrants, scours and caps, T's, reducers etc.
- 1.29.1.12 Road crossing conduit locations, size and class.
- 1.29.1.13 Water service connection details.
- 1.29.1.14 Pump stations and reservoirs (if required).
- 1.29.1.15 Network analysis (if required).
- 1.29.1.16 Type and class of pipes for the pressure and cyclical loading regime.
- 1.29.1.17 Thrust block calculation where required.
- 1.29.1.18 Operating conditions for pressure reducing valves.
- 1.29.1.19 Structural calculations were necessary for valve pits and associated work.

AP 1.30 Landscape Plan

1.30.1 The landscape plan shall contain the following details:

Site and Layout

- 1.30.1.1 Proposed and existing contours at 5 m intervals.
- 1.30.1.2 Extent of existing vegetation including type and location.
- 1.30.1.3 Significant tree showing level at base and proposed levels, indicating which trees/vegetation is to be removed.
- 1.30.1.4 Proposed layout of roadways including:
  - 1.30.1.4.1 kerb and channel.
  - 1.30.1.4.2 Stormwater drainage pits and manholes.
  - 1.30.1.4.3 Street lighting.
  - 1.30.1.4.4 Property boundaries.
  - 1.30.1.4.5 Traffic islands, roundabouts, traffic calming devices etc.
  - 1.30.1.4.6 Existing and proposed water supply, sewerage services and easements.
  - 1.30.1.4.7 Proposed freehold lots covering water supply and sewerage infrastructure.
- 1.30.1.5 Layout and numbering of individual lots, including street names.

1.30.1.6 Existing parks, reserves etc.
1.30.1.7 adjoining land uses, access corridors.
1.30.1.8 Existing watercourses, watersheds, gullies, with a buffer zone to either side of creeks, where required.
1.30.1.9 Revegetation areas including extent, type, technique and erosion prevention proposals.

On-Street Works

1.30.1.10 Alignment and location of proposed concrete foot paths and bike paths.
1.30.1.11 Grass establishment areas.

Traffic Islands and Roundabouts

1.30.1.12 Alignment of kerb and channel and concrete backing to roadside kerb.
1.30.1.13 Soil mixed type and depth.
1.30.1.14 Proposed planting layout and plant schedule, including species, number, size, set out and staking.
1.30.1.15 Mulch types and depth.
1.30.1.16 Irrigation proposals.

Public Open Space

1.30.1.17 Dimensions and landscape treatment to buffer zones.
1.30.1.18 Location and dimension of all off-road bikeways and pedestrian pathways, with trees at 15 m intervals, showing size and species.
1.30.1.19 Location of boundaries to parkland, reserves and easements, including fencing proposals and details of removable vehicle barriers.
1.30.1.20 Location and type of play equipment, if applicable, including type, extent and edge treatment to satisfy surfacing.
1.30.1.21 Proposed lighting.
1.30.1.22 Mounding, showing base, Crown, levels and gradients.
1.30.1.23 Proposed furniture including benches, bins, BBQ's, shade structures, signage.
1.30.1.24 Tabs, drinking fountains, irrigation couplings.
1.30.1.25 Proposed planting and mulched garden beds.
1.30.1.26 Irrigation plan at 1:200 scale.

1.30.2 Detailed specifications will be required to cover all proposed works including the following:
1.30.2.1 play equipment and safety surfacing.
1.30.2.2 The plant schedule.
1.30.2.3 Revegetation requirements.
1.30.2.4 Grass establishment.
1.30.2.5 Mulch.
1.30.2.6 Hard landscaping.
1.30.2.7 Furniture and lighting.
1.30.2.8 Irrigation, if applicable.

AP 1.31 Erosion and Sediment Control Strategy

1.31.1 The Erosion and Sediment Control Strategy shall include:

- 1.31.1.1 A plan of development showing the road and allotment boundaries.
- 1.31.1.2 Existing surface and finished surface contours at an interval close enough to define terrain.
- 1.31.1.3 Contours shall extend beyond the limits of the development site to fully define the limits of external catchments.
- 1.31.1.4 Existing drainage paths and drainage infrastructure.
- 1.31.1.5 Extent of clearing and trees to be removed.
- 1.31.1.6 Line diagram of drain lines and drainage structures.
- 1.31.1.7 The identification and location of all Erosion and Sediment control measures (i.e. catch drains, diversion drains, sediment traps, sediment basins etc.) that are proposed for the period when the site is disturbed.
- 1.31.1.8 Location of sensitive and restricted access areas.
- 1.31.1.9 Existing significant vegetation to be retained.
- 1.31.1.10 Revegetation works.
- 1.31.1.11 Calculations are to be submitted in accordance with QUDM and based on soil type(s) of the site.
- 1.31.1.12 Measures to be employed for each facet of the construction process. As a minimum this is to include stripping/earthworks, trenching/services installation and when stormwater and roadways are completed.
- 1.31.1.13 Consideration for construction during the wet season (typically Nov – Mar) with regard given to increased storm intensity and minimising disturbed areas and for construction during the dry season with regard given to dust suppression.

AP 1.32 Service Providers/Conduit Plan including Street Lighting.

1.32.1 This plan shall include:

- 1.32.1.1 Legend.
- 1.32.1.2 Road Reserve Boundaries.
- 1.32.1.3 Allotment Numbers and Boundaries.
- 1.32.1.4 North Point.
- 1.32.1.5 Kerb and channel or edge of pavement where no kerb is to be constructed;
- 1.32.1.6 Road Crossings Conduits Type and size.
- 1.32.1.7 Location of Pad Mount Transformers.
- 1.32.1.8 Location of Telecommunications Authority's Roadside Cabinets & Shelters and Cables;
- 1.32.1.9 Location of Street Lighting including designation of hierarchy of all roads.
- 1.32.1.10 Location of Electricity Authority's Cables and Facilities paying particular attention to connection to existing power supply.
- 1.32.1.11 Electrical reticulation plans.
- 1.32.1.12 Gas pipes, valve, syphon points and storage facilities.

AP 1.33 Stormwater Catchment Plan/Drainage Calculations Tabulation.

1.33.1 A catchment plan shall be submitted, for Council submission purposes only and shall not form part of construction documentation. The catchment plan shall include the following:

- 1.33.1.1 North point.
- 1.33.1.2 A plan of the development showing the road and allotment boundaries.
- 1.33.1.3 Existing and finished surface contours (in different line types) and an interval close enough to define the terrain And Allow Definition of the Sub- Catchment.
- 1.33.1.4 Contours Shall Extend beyond the Limits of the Development Site to fully define the limits of external catchments.
- 1.33.1.5 Sub- catchment boundaries, labels and areas.
- 1.33.1.6 Line diagram of drain line, manhole, gully and outlet locations.
- 1.33.1.7 Labelling of stormwater structures.
- 1.33.1.8 Adjacent to each stormwater pit tabulation is to be provided illustrating the roadway approach flow, the width of approach flow, and the bypass flow.
- 1.33.1.9 Overland flow paths.
- 1.33.1.10 Proposed easements.
- 1.33.1.11 Stormwater calculation shall be in a spreadsheet format in accordance with the QUDM. This tabulation should include a bypass flow width valve at all kerb return pits.

AP 1.34 Pest Plant Management

1.34.1 In accordance with the *Land Protection (Pest and Stock Route Management) Act* 2002 the applicant must not remove soil or any matter containing reproductive pest plant material and transport such matter to another location. Appropriate measures must be put in place to ensure that soil and other organic materials are not inadvertently (or otherwise) transported to other locations.

1.34.2 Prior to the issue of a development permit for operational works, the applicant must:

- 1.34.2.1 Clearly state if there is an excess amount of soil on the development site.
- 1.34.2.2 Provide appropriate documentation to show where any excess soil is to be used or placed on the site.
- 1.34.2.3 Provide a plan which indicates where a shakedown or wash down area will be placed to ensure that all vehicles entering and exiting the development site are subject to a cleansing procedure to remove soil and any other organic materials.

1.34.2.4 Construct a shakedown or wash down area during the first stage of development. This is not to be in the vicinity of a creek, or a waterway or drain which leads to a creek or other water body.
1.34.2.5 Permanently contain material within the site inclusive of shakedown area.
1.34.2.6 Maintain the site to a point of sale so that declared weeds are eradicated or controlled.

1.34.3 Soil or other matter contaminated with weed seed or organic material should not be used in landscaping e.g. buffer mounds.
1.34.4 Reference should be made to Council pest management unit to obtain advice.
1.34.5 These conditions relate to all class 1, 2 and 3 plants identified in the *Land Protection (Pest and Stock Route Management) Act* 2002.

AP 1.35 Miscellaneous Details

1.35.1 Detailed are required for the following either on separate drawings or appropriate service plan:
1.35.1.1 stormwater inlet and outlet structures, other than standard headwinds.
1.35.1.2 Manhole details where pipe alignments are critical for clearances or flow considerations.
1.35.1.3 Water quality permanent works structures (SQIDs, sediment basins, trash racks etc).
1.35.1.4 Details of erosion control and stormwater management structures.
1.35.1.5 Surcharge structures.
1.35.1.6 Overland drainage paths
1.35.1.7 sewer and water pump stations showing all relevant levels and dimensions for pumps etc (where not provided elsewhere).
1.35.1.8 Footbridges.
1.35.1.9 Reservoirs.
1.35.1.10 Water source treatment/disinfection works.
1.35.1.11 Entry structures.
1.35.1.12 Retaining walls.
1.35.1.13 Buildings.
1.35.1.14 And any details or variations from standard drawings.

AP 1.36 Design Records

1.36.1 The designer shall provide Council with appropriate design records in a format such that design staff with no prior knowledge of the particular design can understand them readily.
1.36.2 A design file shall be maintained by the developer or the developers designer containing records of calculations, approvals and decisions, geotechnical data and

other design data which could be relevant in reviewing aspects of the design or planning future maintenance responsibilities.

1.36.3 The developer is to provide a detailed submission for all structures being built as part of the development, for separate building approval and inspection. Submission is to include detailed design plans and a structural certificate from RPEQ.

CP1 – Construction Procedures

General

CP 1.01 Introduction

1.01.1 This section of this Development Manual details the minimum requirements acceptable to the Council associated with developments involving operational works defined as any works to be constructed that are subject to Council approval. Typically, this involves the construction of water supply, sewerage, stormwater, roadworks and public open space associated with development, reconfiguration or other approvals.

1.01.2 This manual does not apply to works of services under the control of other authorities (i.e. works within state-controlled road corridors). Separate approvals may be required from the other relevant authorities.

1.01.3 This section has been divided into four subsections as follows:

1.01.3.1 Requirements prior to construction.

1.01.3.2 Requirements during construction.

1.01.3.3 Acceptance of works.

1.01.3.4 Final acceptance of works.

Requirements Prior to Construction

CP 1.02 General Requirements

1.02.1 Prior to the construction of any works associated with the development approval which requires operational works approval by Council, the designer responsible for the design of the works must first obtain an approval of the design, construction drawings and specifications from Council. The procedures to be undertaken in order to achieve approvals are outlined in detail in section AP1 of this manual.

CP 1.03 Construction Inspections

1.03.1 Prior to construction of the works the consulting engineer who is an RPEQ is to be engaged to be responsible for the provision of inspection services in accordance with a Council approved Inspection and Test Plan (ITP) and to exercise reasonable skill and diligence in order to ensure that the operational works requiring approval are executed in accordance with:

1.03.1.1 Council's development permit conditions;
1.03.1.2 Council's relevant policies and local laws;
1.03.1.3 This manual, Council approved drawings, specifications and relevant Australian Standards;
1.03.1.4 Good engineering practice; and
1.03.1.5 Records compatible with Council's asset management information recording system are provided.

1.03.2 Inspections may be carried out by the consulting engineer or a delegate who shall be suitably qualified/experienced person approved by the consulting engineer.

1.03.3 The consulting engineers required to certify that all works have been carried out in accordance with the development approval and to WRC minimum standards prior to works acceptance.

CP 1.04 Inspection and Test Plan

1.04.1 The Contractor is to prepare an ITP (endorsed by the RPEQ) identifying the following items:

1.04.1.1 Element of work;
1.04.1.2 tests and checks required;
1.04.1.3 standard required to meet;
1.04.1.4 frequency of testing;
1.04.1.5 contractor's responsibility;
1.04.1.6 consulting engineer's responsibility;
1.04.1.7 Council's responsibility; and
1.04.1.8 asset data recording requirements.

Refer to CP 1.16 and Form 2 – Security Lodgement Form

This sheet must be completed prior to the acceptance of any bond by Council.

Development Name:	
Stage:	
File No.:	
Applicant:	

Consultant:	
Purpose of Bond:	

Uncompleted Works Bond Assessment:

Estimated time to complete bond works (not greater than 90 days)	days
Current contract completion date	
Anticipated completion date	
Consulting engineers estimated value of uncompleted works	
Bond value (apply factor 1.50)	

Construction/defects liability bond assessment :

Consulting engineer's estimated value of completed works	
Construction/maintenance bond value (apply factor 0.05) (min $500)	

Council shall retain any interest accrued on cash monies paid to Council and held in trust by Council.

Consulting Engineer:

Signature:

RPEQ No.

Date:

Form 3 – Inspection Certificate for Witness/Hold Point

This certificate registers evidence that the works as noted herein have been inspected by the Council officer noted below and were found to be satisfactory.

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Contractor:	

Works being inspected/Tested/Witnessed:

Defaults/Corrective Action Required:

Defaults Corrected?	Y	N	N/A

Council Inspector Signature:

Name of Inspector:

Date of Inspection:

Form 4 – Works Acceptance Inspection Checklist

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Contractor:	

Item	Verification (Yes/No/N/A)	Comment
ALLOTMENT DRAINAGE The works have been finally inspected and:		
1. Concrete catch drains constructed in approved location and to a satisfactory standard;		
2. Field inlets constructed in approved location and to a satisfactory standard;		
3. Overland flow path constructed to correct profile;		
4. Pipework has been visually inspected and is satisfactory in terms of: a. alignment and grade; b. free of debris and siltation; c. no visual sign of trench subsidence; and d. outlets are satisfactory.		
5. Lots not provided with allotment drainage can be drained to the kerb and channel.		
STORMWATER DRAINAGE SYSTEM The works have been finally inspected and:		
6. Pipe layout is as per plan or approved amendments with respect to pipe size, levels and location.		

7. Pipework has been visually inspected and is satisfactory in terms of: a. alignment and grade; b. free of debris and siltation; c. lifting plug holes sealed; d. no visible sign of trench subsidence; and e. no damaged pipes.		
8. Gully pits and manholes have been constructed to the correct standards i.e.: a. Correct type of grate or cover; b. Lintels; c. side entry slots; d. benching (no water ponding) e. grates are satisfactorily sealed in frames; f. we poles provided to bedding material; g. no damaged structures; h. converter slabs/sections mortar bedded; i. correct drops through gullies/manholes; and j. all lids/grates finished to match surface level.		
9. All density tests to backfill are available and satisfactory.		
10. Material gradings are available for bedding material and are satisfactory;		
11. Outlets/inlet structures are satisfactorily constructed and are free from scour or siltation.		
12. All manhole and gully pit pipe connections are mortared flush with the walls and no pipe reinforcement is exposed.		
13. Open cut channels have been finally inspected and a satisfactory i.e.: a. Cut to design profiles; and b. lining of channel is to the required thickness and		

reinforcement, with appropriate weep holes.		
14. Overland flow, the works have been finally inspected an appropriate flow paths are provided and clear of obstruction.		
15. Outlets and outfalls have been constructed to control discharge flow in accordance with the plans.		
16. Subsoil drainage discharges to gullies or other approved point of discharge.		
17. All grousing requirements to channels, swales, outlets, inlets etc have been completed.		
18. CCTV inspection of stormwater pipes completed.		
WATER QUALITY The Works have been finally inspected and:		
19. Water quality structures have been constructed in accordance with approved engineering drawings;		
20. Structures are free of debris and sediment.		
EROSION AND SEDIMENT CONTROL The works have been finally inspected and:		
21. Control structures required until the site is stabilised in accordance with the contractor's ESCP are in place.		
22. Structures are free of debris and sediment.		
EARTHWORKS The Works have been finally inspected and:		

23. Toe of batters not on Council Road reserve except as approved.		
24. Retaining walls clear of Road reserve except as approved.		
25. Retaining walls constructed in accordance with drawings.		
26. Batter slopes constructed in accordance with drawings.		
27. Batter slopes stabilised against erosion.		
28. Interim drainage constructed in accordance with drawings.		
29. All areas disturbed by the works have been rehabilitated.		
30. Allotment levels are as per the design plans.		
31. Verge levels are as per the design plans.		
SEWER RETICULATION The Works have been finally inspected and:		
32. Pipe layout is as per the plan or approved amendments with respect to pipe size, levels, and location.		
33. Pipework has been visually inspected and is considered satisfactory, i.e.: a. Pipework flush with internal walls of manhole; b. alignment and grade; c. flexible joints; d. line flushed and cleaned; e. no visible sign of trench subsidence; f. a density test of backfill is available and satisfactory; g. CCTV survey results submitted and satisfactory.		
34. Manholes and maintenance shafts have been constructed to the correct standards, i.e.:		

a. Cast in situ; b. Benching; c. curvature satisfactory; d. no ponding; e. profile satisfactory; f. no weeps (free of infiltration); g. concrete work; h. no honey combing; i. covers; j. covers checked to be gas tight; k. correct type; l. imprint in accordance with standards; m. depth of cover surround; n. depth of top slab; o. location; p. relative to allotment boundaries; and q. 50 to 75 mm proud of finished surface level.		
35. Material gradings for bedding material are available and satisfactory.		
36. Pressure test results are available and satisfactory.		
37. Manhole hydrostatic test all satisfactory.		
38. Sewerage connection Private Works fees paid.		
39. On-site sewer report provided (if applicable).		
40. PUMP STATION - refer separate PS checklist.		
WATER RETICULATION The works have been finally inspected and:		
41. Pipe layout and services fixtures (valves and hydrants) are as per the plan or approved amendments with respect to pipe size and location.		
42. Pipework has been pressure tested in accordance with Council's		

requirements and test results are available and satisfactory.		
43. Pipework has been chlorinated in accordance with Council's requirements.		
44. There are no visible signs of trench subsidence for leaks.		
45. Valves and hydrants have been inspected and a satisfactory, i.e.; a. Location; b. setts and surrounds correctly installed to prevent ingress of soil, etc; c. mortar packing to boxes correctly completed; d. depth to top of hydrant or valve stem within limits; e. dust caps to hydrants; f. colour of marker plate correct; g. direction of flow indicated; h. marking plates correctly installed; and i. size of plate correct.		
46. Material gradings for bedding material are available and satisfactory.		
47. Water supply connection Private Works fees paid.		
48. PUMP STATION - refer separate checklist.		
ROAD PAVEMENTS The works have been finally inspected and:		
49. Plan layout and geometry of Road system is in accordance with the drawings.		
50. Finish levels at Crown and channel are at design levels.		
51. Cross falls are to the approved plan.		
52. AC is satisfactory with regards to finish and thickness.		

53. Joints in the seal (especially where various development stages apply) are flush.		
54. The sealed surface is free of blemishes.		
55. All compaction test, material quality (CBR), material grading, AC core tests are satisfactory and available.		
56. Ponding of stormwater does not occur.		
SEGMENTAL PAVERS (Where Constructed) The Works have been finally inspected and:		
57. All pavers have been correctly laid to pattern, within allowable tolerance, compacted, and the joints filled;		
58. Bedding sand for pavers drains to subsoil drainage.		
59. Pavers adjacent to concrete kerb and channel, edge restraints etc have been cut and laid in accordance with all relevant requirements.		

Form 5 – Registered Engineer's Certification of "As Constructed" Works

This certificate registers evidence that the locations, surface and invert levels of all works and infrastructure presented on the drawings noted below and in the digital ADAC data have been surveyed and meet the accuracy standards as defined within the WRC Development Manual.

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Contractor:	
Surveyor Name:	
Surveyor Firm:	

Drawings & Documents pertaining to the above:

Signed:

Date:

Form 6 – Registered Surveyor's Certification of "As Constructed" Works

This certificate registers evidence that the "As Constructed" drawings submitted herewith have been prepare, checked and amended in accordance with the requirements of the WRC Development Manual and that the completed works comply with the requirements therein.

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Consulting Firm:	
Surveyor Name:	
Surveyor Firm:	

Certification by Registered Surveyor (Consulting) attached: Yes / No

(Note: Certification is to be in accordance with the Development Manual).

Compliance with the manual Design Intent and Function not compromised by the "As Constructed" Works	**Compliance Yes/No**	**Non-Compliance refer to attached redesign of works to ensure satisfactory performance**
Earthworks		
Roadworks		
Stormwater Drainage		
• Flow System and Structures		
• Major Flow System and Structures		
Water Reticulation		
Sewerage Reticulation		
"As Constructed" Documentation		

Signed:

RPEQ No.

1.04.2 Date: The consulting engineer in undertaking construction inspections shall:

1.04.2.1 allocate competent and experienced after site inspection and testing;
1.04.2.2 provide sufficient site presence, dependent on the contractor's progress and workmanship, and in accordance with the ITP, to be reasonably satisfied that the works meet the design, specification and performance requirements; and inspect and confirm acceptability of works is complying with the design intent and in accordance with the Council's requirements trying to request a Council inspection.

CP 1.05 Contractor's Erosion & Sediment Control Plan

1.05.1 Prior to construction commencing the contractor shall prepare an Erosion and Sediment Control Plan (ESCP) to manage the site during construction and the defects liability period.
1.05.2 The plan shall be consistent with the approved Erosion and Sediment Control Strategy (ESCS) and shall take into consideration the contractor's proposed construction methodology and program.
1.05.3 The contractor may propose an alternative construction methodology that differs from the approved ESCS. In this instance the contractor shall discuss and obtain approval from the consulting engineer for the alternative strategy prior to submitting to Council.
1.05.4 The contractor's ESCP must be prepared by a suitably qualified person meeting the following criteria:
1.05.4.1 Six years or more field experience in civil engineering construction practices;
1.05.4.2 educated in erosion and sediment control practice through regular industry sponsored seminars, publications, etc;
1.05.4.3 an understanding of rainfall hydrology and an ability to calculate rainfall run-off; and
1.05.4.4 an understanding and ability to calculate open channel flows and velocities.
1.05.5 A copy of the contractor's current approved ESCP is to be retained on site by the contractor's representative.
1.05.6 The contractors ESCP shall be submitted to the consulting engineer for review and approval prior to the pre-start meeting.
1.05.7 The consulting engineer is to review the ESCP for compliance with the approved ESC S. Any amendments required to ensure ESCS compliance are to be incorporated by the contractor prior to approval. The consulting engineer will issue a copy of the approved ESCP to the Council prior to the pre-start meeting.
1.05.8 It is the contractor's responsibility to ensure that the ESCP is updated and amended to reflect any changes in the construction methodology and program.
1.05.9 All amendments to the contractors ESCP shall be approved by the consulting engineer and a copy of the revised approved ESC P issued to Council.
1.05.10 The contractors ESC P shall consist of the following:

1.05.10.1 A layout plan detailing the measures to be employed during construction. On larger sites were works are to be progressively constructed a plan shall be provided for each stage of works;
1.05.10.2 A layout plan detailing the measure(s) to remain in place from the commencement of the defects liability period;
1.05.10.3 a written description of the sequencing of works or construction program;
1.05.10.4 an inspection and test plan for monitoring erosion and sediment control measures during the construction and the defects liability period.
1.05.10.5 Details of all erosion and sediment control measures to be used. The contractor may adopt standard details developed by others e.g. the IECA Best Practice Erosion and Sediment Control manual.
1.05.10.6 The name of the person within the contractor's organisation who has the authority and responsibility for implementing, monitoring, updating or amending the plan.

1.05.11 The contractors ESCP shall address the following issues:

1.05.11.1 Minimising Disturbance:
1.05.11.1.1 limiting the exposure time and size of disturbed areas to a minimum;
1.05.11.1.2 allow for the use of existing vegetation has buffer zones.

1.05.11.2 Control of Runoff:
1.05.11.2.1 sizing of structures, channels, catch strain and diversion drains for appropriate storm events in accordance with the following table:

	Design Life	ARI
Non-erosive design capacity	0-6 months	1 year
	6-12 months	2 year
Structural stability	0-6 months	5 years
	6-12 months	10 years

1.05.11.2.2 Diverting clean water run-off around disturbed areas;
1.05.11.2.3 dividing the site into smaller more manageable drainage areas;
1.05.11.2.4 early installation of temporary drainage works;
1.05.11.2.5 early installation of permanent drainage system and protection works.

1.05.11.3 Erosion Control:
1.05.11.3.1 protecting service changes and hard engineering structures (eg. driveways, curbs, etc) from erosion caused by run-off;
1.05.11.3.2 prompt revegetation of disturbed areas;
1.05.11.3.3 installing structures and drainage channels to flow velocity and encourage settlement of soil particles;

1.05.11.3.4 protection of disturbed areas from wind erosion (dust suppression).

1.05.11.4 Sediment Control:

1.05.11.4.1 locating stockpiles clear of drainage paths and protecting stockpiles from traffic, run-off and wind erosion;

1.05.11.4.2 minimising number of site access points;

1.05.11.4.3 stabilising site access points to prevent vehicles transporting materials off-site;

1.05.11.4.4 intercepting drainage from disturbed areas and installing sediment barriers to slow the velocity of flow and allow fine particles to settle;

1.05.11.4.5 diverting larger contaminated flows to sediment traps to allow soil particles to settle or to be treated prior to release into receiving waters; and

1.05.11.4.6 protecting partially constructed drainage structures from sediment infiltration.

1.05.11.5 Revegetation:

1.05.11.5.1 Progressive stabilisation and rehabilitation of completed works; and

1.05.11.5.2 providing protection to revegetation works on steep batters during establishment period.

1.05.11.6 Inspection, cleanout and maintenance:

1.05.11.6.1 the inspection, cleanout and maintenance regime are to take into account the duration that the site will be disturbed and the timing of construction. If the site is disturbed (i.e. rehabilitation works are not complete) during the period December to May (wet season) a more rigorous inspection, cleanout and maintenance regime will be required then for a site which is disturbed during the period June to November.

1.05.11.6.2 The following references/guidance it may assist in preparing the ESCP:

- Best Practice Erosion and Sediment Control, International Erosion Control Association (Australiasia) 2008;
- Queensland Urban Drainage Manual;
- Guidelines for the Preparation of Erosion and Sediment Control Plans for Building Sites, Cairns City Council, July 2003;
- Erosion and Sediment Control Standard Version 9, Brisbane City Council, 2000

CP 1.06 Construction Security Bond.

1.06.1 Prior to construction of the works commencing the developer is required to lodge a security bond in cash or unconditional bank guarantee to the value of 5% of the

estimated cost of the construction of the works prepared and certified by the consulting engineer.

1.06.2 A bank guarantee should:
- 1.06.2.1 Be a binding contractual relationship between Council and the guaranteeing bank;
- 1.06.2.2 Include specific requirements for renunciation of the guarantee;
- 1.06.2.3 require adequate notice of renunciation;
- 1.06.2.4 not have an expiry date.

1.06.3 The bond is to be accompanied by Council's Security Lodgement Form (Form 2) clearly identifying the purpose of the bond together with the consulting engineer's certification of the value of the works.

1.06.4 The bond is required to provide security to Council in the event that costs are incurred as a result the following:
- 1.06.4.1 protection of on street works from damage by contractors, subcontractors and suppliers;
- 1.06.4.2 repairs to on street works resulting from damage caused by contractors, subcontractors and suppliers;
- 1.06.4.3 protection and repair of existing Council services (i.e. sewerage connections, water connections et cetera);
- 1.06.4.4 non-compliance with the approved Erosion and Sediment Control Plan during construction;
- 1.06.4.5 failure to provide adequately for traffic; and
- 1.06.4.6 urgent action required by Council to resolve unsafe construction or emergency repairs required to protect persons and/or property from consequential damages.

1.06.5 Any costs incurred by Council in responding to the above circumstances will be recovered from the security bond.

1.06.6 At the completion of the works and the commencement of the defects liability period, the construction security bond shall be returned to the developer or may be substituted for the defects liability bond.

CP 1.07 Notice of Commencement of Work

1.07.1 A notice of intention to commence works is to be issued to Council in writing seven days prior to the intended date for commencement of the works. No works will be permitted to commence until the following information is provided:
- 1.07.1.1 name, address and telephone number (including after-hours contact) of the consulting engineer for the works;
- 1.07.1.2 name, address and telephone number (including after-hours contact) of the contractor and major subcontractors for the work;
- 1.07.1.3 name and telephone number of the person to be contacted in regard to any matter arising from the construction of the works;
- 1.07.1.4 intended date of commencement of works, and contract period;
- 1.07.1.5 an invitation to the relevant Council representative to attend the pre-start meeting and confirmed by phone or email and minimum of 24 hours prior;

1.07.1.6 a request to Council to confirm that environmentally significant areas and/or trees which are to be preserved in accordance with any tree preservation declaration, have been identified and adequately protected;
1.07.1.7 location of project sign (if required);
1.07.1.8 and inspection and test plan (refer CP 1.16).

1.07.2 This submission will form notification of the date of the "pre-start" meeting.

CP 1.08 Documentation to Be Provided Prior to Pre-Start Meeting.

1.08.1 The following documents (to a standard acceptable to Council) are required to be submitted and accepted by Council prior to the pre-start meetings:
1.08.1.1 evidence of public liability insurance.
1.08.1.2 Proof of payment of Portable Long Service Leave Levy (PLSL);
1.08.1.3 contractor's erosion and sediment control plan;
1.08.1.4 traffic management plan;
1.08.1.5 construction security bond;
1.08.1.6 safety plan;
1.08.1.7 evidence that all fees and charges have been paid; and
1.08.1.8 cultural heritage management plan (if applicable).

1.08.2 The site safety induction is to be undertaken for each Council representative at initial attendance on site (prior to initial inspection);

1.08.3 evidence of Concurrence Agency, Service Authority or adjoining land owner consents/approvals is to be provided to Council prior to commencing any elements of work affecting/involving those parties;

1.08.4 the project specific Inspection and Test plan endorsed by the RPEQ.

CP 1.09 Pre-Start Meeting

1.09.1 A pre-start meeting is to be held prior to the commencement of works. The meeting is to be attended by consulting engineer, the contractor's representative, any relevant specialist consultants and Council's representative.

1.09.2 Items to be considered at this meeting will include but not be limited to the following:
1.09.2.1 review of relevant conditions of development approval and discussion of any issues including conditions of the development permit and operational works approvals that are considered important and relevant to the attending parties;
1.09.2.2 review of Council's construction requirements;
1.09.2.3 discuss the Contractor's ESCP approved by the consulting engineer;
1.09.2.4 a review of the processes for monitoring, compliance assessment and auditing of the ESCP;
1.09.2.5 inspection and identification of parks and environmentally significant areas and/or trees for preservation;
1.09.2.6 site access conditions;

1.09.2.7 identification of areas to be left undisturbed;
1.09.2.8 evidence of compliance with the Workplace Health and Safety Act, including site safety inductions, site safety plans, notifications;
1.09.2.9 review of ITP including a notice of nominated hold/witness point;
1.09.2.10 relevant provisions of any other Acts;
1.09.2.11 Traffic Management Plan;
1.09.2.12 location of project sign (if required);
1.09.2.13 sewerage and water pump station commissioning plan (if applicable to the project); and issue plans for construction are the latest approved plans.

1.09.3 The pre-start meeting is a Hold Point and works may not proceed until the meeting is held and any further requirements identified during the conduct of the meeting are satisfied.

1.09.4 Council may require that subdivisions in difficult terrain or environmentally sensitive areas to have all road centre lines pegged prior to the pre-start meeting. This is to occur at least two weeks prior to any construction activity taking place so Council can visit the site with Engineers and Contractors representatives to view first had ramifications of such construction activities as stormwater drainage points, proposed earthworks areas, clearing etc. Council reserves the right to amend the design in consultation with engineers should any problems arise as a result of the inspection. This preliminary site visit should be arranged prior to or in conjunction with the pre-start meeting.

Requirements During Construction

CP 1.10 General Requirements

1.10.1 The general requirements during construction of the project are as follows:
1.10.1.1 work may only proceed subsequent Council being issued with all the relevant documentation set out in CP 1.09;
1.10.1.2 no work shall commence on any existing open Road to the public unless specifically approved by Council;
1.10.1.3 no work may be carried out nor machinery driven above or near existing water and sewerage pipes without a work method statement being submitted by the contractor and approved by Council;
1.10.1.4 any damage to existing services under the control of Council or another authority must be notified immediately and made good by the relevant authority at the contractor/developer's expense prior to acceptance of the works;
1.10.1.5 use of Council services (e.g. water from existing mains) is subject to approval by Council and payment of appropriate fees;
1.10.1.6 work involving the use of machinery of any description shall only be carried out on the site 6:30 AM to 6:30 PM Monday to Saturday, with no work to be carried out on Sundays or public holidays. (In certain

circumstances Council may approve works outside these hours. All applications for changes to working hours must be in writing). For emergent or complaint response issues, dust suppression and sedimentation control may occur outside these hours. Council is to be notified as soon as possible in this instance; and

1.10.1.7 pumping stations, electrical switchboards, access covers, compounds and associated equipment installed during construction shall be padlocked when left unattended.

1.10.2 The developer, contractor and consulting engineer shall take all necessary steps, in accordance with the provisions of the workplace health and safety act, to ensure safety of the public in regard to construction activities. In particular, work on roadways shall be signed in accordance with the MUTCD. Council will require submission of plans indicating traffic control proposals and a program of work for sites involving the travelling public.

1.10.3 No public road may be closed, traffic diverted from public roads, or traffic diverted elsewhere without the prior approval of Council, Police and public advertising of the proposed diversion must be carried out. Proposals to divert traffic shall include full details of the alternative route and proposed signage.

1.10.4 Works shall not be undertaken on any adjoining private properties without the prior written consent of the relevant registered proprietor. A written acceptance (by the registered proprietor) of the completed work shall be submitted to Council upon finalisation of the work.

1.10.5 If connections or alterations to Council mains are required, the Council engineer shall be given a minimum of 10 working days' notice of the contractor's requirements (Council's notification requirements are to be noted on the project drawings/specifications).

CP 1.11 Public Notices/Project Signage

1.11.1 Where is a condition of approval, Council requires a project sign(s) to be erected on the sites frontages to constructed roads and any other location as required, the sign shall contain the following information:

1.11.1.1 An overall concept plan of the development showing the stage or works about to commence construction;

1.11.1.2 name of the developer;

1.11.1.3 name of the project;

1.11.1.4 Street address of the site;

1.11.1.5 project manager's name and contact number;

1.11.1.6 consulting engineer's name and contact number;

1.11.1.7 contractor's name and contractors number; and

1.11.1.8 other specialist consultants (geotechnical, landscaping, architects, hydraulics et cetera) names and contact numbers.

1.11.2 Material and size of the sign shall be as follows:

1.11.2.1 Made of weatherproof material; and

1.11.2.2 Not less than 1200mm x 900mm.

1.11.3 Position of the sign on the land:
- 1.11.3.1 the sign must be placed on, or within 1.5 m of, the road frontage of the land;
- 1.11.3.2 the sign must be mounted to at least 300 mm above ground level; and
- 1.11.3.3 the sign must be positioned so that it is visible from the road.

1.11.4 The lettering on the sign:
- 1.11.4.1 each item listed above must start on a new line; and
- 1.11.4.2 the minimum lettering height shall be 50 mm in height.

CP 1.12 Document Control

1.12.1 A copy of the approved project drawings, specification and operational works approval shall be kept on the job site at all times during construction.

1.12.2 Should amendments be required to engineering plans and/or specifications during construction, the consulting engineer shall ensure that Council and any other person or organisation who has previously been issued a set of plans that may be affected by this amendment (e.g. registered surveyor, public service authority) is in receipt of a copy of all amended drawings and/or specifications. When approved, Council shall stamp these plans for approval as Operational Works plans. Any amended drawings and/or specifications shall be submitted with an accompanying letter outlining the amendments together with any supporting information.

1.12.3 Submissions with a full complement of supporting documentation will expedite Council's approval timeframes.

1.12.4 All amendments shall be issued to Council for approval prior to the works being undertaken.

CP 1.13 Erosion & Sediment Control

1.13.1 The consulting engineer shall ensure that the construction contract contains provisions requiring the contractor to implement the approved ESCS and to prepare and implement an ESCP complying with the approved strategy.

1.13.2 The contractor shall ensure that all reasonable measures are taken to protect nearby properties from dust pollution, erosion, siltation or sediment transport.

1.13.3 Council reserves the right to order whatever action deem necessary and appropriate at the time to prevent environmental harm, including ordering temporary cessation of work in extreme cases.

1.13.4 As erosion and sediment control is also an issue of public amenity and safety, the developer shall be responsible for any costs arising from dust or water pollution generated by its development.

CP 1.14 Noise

1.14.1 The requirements of the *Environmental Protection Act* 1994 regarding nuisance noise (if applicable) shall apply to the development works.

CP 1.15 Parks & Environmentally Significant Areas

1.15.1 In cases where the subject land or the adjacent land is an existing or proposed park, bushland reserve or area otherwise declared by Council as environmentally significant, the following general precautions shall be mandatory:

1.15.1.1 the areas should be clearly pegged, flagged, (and fenced if ordered by Council) inspected and approved by Council officers;

1.15.1.2 the approved design, or certificate of approval for tree clearing issued pursuant to tree preservation bylaws (if applicable) shall have identified any unavoidable intrusion into such areas and nominated work practices such as maximum widths of disturbances, nominated access routes, methods and timing of rehabilitation, which shall be strictly adhered to.

1.15.2 Council should be notified immediately when the consulting engineer is aware of any damage or disturbance beyond the approved limits. Rehabilitation of this damage or disturbance shall be to the satisfaction of Council.

CP 1.16 Inspection & Testing

1.16.1 During the construction phase, the consulting engineer shall be responsible for undertaking the minimum number of required inspections and tests in accordance with the approved Inspection and Test Plan (ITP).

1.16.2 There are a number of major inspections that are mandatory hold points (H) for the consulting engineer and Hold Points or Witness Points for Council. These will be included in the ITP and can be found in Appendix A which contains inspection and test plan templates. The contractor's ITP is to be based on these templates and updated with project specific testing requirements.

1.16.3 Any proposed changes to the ITP must be notified to and accepted by Council prior to the affected works commencing.

1.16.4 The submitted ITP is to be implemented by the consulting engineer. The test results and effort certification that the plan has followed are to be submitted with the "as constructed" documentation.

1.16.5 Council will, on a random basis, call upon the consulting engineer to provide evidence of conformance with the approved ITP in the form of diary records, site visit reports etc.

1.16.6 During construction, Council reserves the right to conduct audit inspections of any or all of the works without prior notification. These inspections do not release the consulting engineer from his responsibility to check the contractor's work.

1.16.7 For the RPEQ's test inspections and Hold/Witness Points, a "Certificate of Inspection" will record the inspections. If requested, copy is to be provided to Council for each Hold Point/Witness Point inspection.

1.16.8 For Council Hold/Witness points, the RPEQ's information will include as a minimum the details contained within Form 3.

CP 1.17 Application for Council to Complete Private Works

1.17.1 unless otherwise approved, Council requires any connections and alterations to Council's live sewer and water mains associated with developments to be completed by the developer at the developer's expense subject to Council's approval and supervision.

1.17.2 Sewer and water mains are considered to be live once the defects liability period has commenced. All work on live sewers and water mains must be carried out by the contractor with Council approval and subsequent supervision.

1.17.3 Alterations and connections to existing Council sewer and water mains, resulting from the development (including cutting in of new sewer property connections) are to be completed prior to commencement of the defects liability period. In these cases, separate applications should be made for the alterations and the connections.

1.17.4 Contractors are not permitted to operate Council's infrastructure unless written approval has been obtained from Council. The placement and removal of plugs within live sewers must be done under direct supervision of Council's inspector.

1.17.5 Council reserves the right, on the advice of its inspector, to stop, or take over a connection being undertaken by a contractor, if in the inspector's opinion the contractor is incapable of completing the connection work in a reasonable time without causing damage to Council's infrastructure or undue inconvenience to the public. Any work carried out by Council will be at the contractor's cost.

CP 1.18 Application for Approval to draw water from Council Mains

1.18.1 The drawing of construction water from Council's mains must be approved and the relevant fees paid in advance.

1.18.2 Permission to draw water shall be subject to the following conditions:

- 1.18.2.1 backflow prevention;
- 1.18.2.2 water mainly be taken between the hours of 8 AM and 4:30 PM;
- 1.18.2.3 the approval shall be limited to the days and dates nominated in Council's notice of approval;
- 1.18.2.4 water money be taken from the approved hydrant point;
- 1.18.2.5 a copy of this approval is to be held by the driver of any vehicle taking water covered by this approval;
- 1.18.2.6 Council may withdraw this approval at any time, such notice shall be in writing and will become effective immediately; and
- 1.18.2.7 the applicant is responsible for the cost of reinstatement of damage to Council's property caused by the taking of water covered by this permit.

Acceptance of Works

CP 1.19 Introduction

1.19.1 Full works requiring Council approval a “Defects Liability” period is a period of 12 months minimum (or other period as Council so shall require in its absolute discretion) after the works have been accepted as complete by Council. During the defects liability period, it is the responsibility of the developer to rectify any works found to be defective due to design faults or found to exhibit faults attributed to the performance of the construction activities in terms of quality and conformance with the design and specifications.

1.19.2 The following are required to be completed prior to Council acceptance of works:

- 1.19.2.1 completed “as constructed” submission lodged with Council a minimum five days prior to the “Works Acceptance” inspection or early plan sealing inspection for bonding or uncompleted works and being to Council satisfaction;
- 1.19.2.2 satisfactory “Works Acceptance” inspection;
- 1.19.2.3 all documentation outlined in CP 1.25(2) submitted to and accepted by Council;
- 1.19.2.4 all appropriate documentation to be completed by the consulting engineer and retained for records purposes. This consists of the “Works Acceptance Inspection Checklist” (Form 4), the certified ITP and all test results and records for the works.
- 1.19.2.5 Approval has been given by Council or private certifier for construction of any buildings forming part of the operational works approval; and
- 1.19.2.6 satisfactory commissioning and acceptance of any water pump station, reservoir or sewerage pump station.

1.19.3 Following the satisfactory completion of all of the above matters, the consulting engineer shall make a written request for acceptance of the works and commencement of the “Defects Liability” period and lodgement of any uncompleted Works Bonds.

1.19.4 The date of the works acceptance shall be the date of issue of the Works Acceptance certificate an shall be taken as the date all documentation outlined in CP 1.25 has been approved and conditions of the operational works and development approval have been met. Works acceptance will not be backdated to the date of the works acceptance inspection. The assets will become Council’s at the date on the work acceptance certificate.

1.19.5 Prior to making application for works acceptance the consulting engineer must confirm that all non-compliant work is rectified by the contractor. Any non-compliance is found by Council must be rectified prior to Council’s issue of a Works Acceptance certificate. It is the responsibility of the consultant to monitor the contractor’s work to the extent necessary such that any deviations from the design are approved prior to making application for works acceptance, alternatively the consultant must instruct the contractor to rectify the work.

CP 1.20 Defects Liability Bond

1.20.1 Council requires a bond equivalent to a minimum of 5% of the value of the works (or such other amount as Council deems appropriate in its sole discretion), which is kept for the Defects Liability period, or until the works are finally accepted.

1.20.2 The bond is to be submitted with Council's Security lodgement form (Form 2) clearly identifying the purpose of the bond together with the consulting engineers certification of the value of the works.

1.20.3 The construction security bond lodged prior to construction may be used for the purposes of the defects liability bond subject to Council's approval.

CP 1.21 "As Constructed" Submission

1.21.1 "As Constructed" documentation serves two distinct functions:

1.21.1.1 Evidence that "As Constructed" works have been checked against the approved design, to support certification by the consulting engineer responsible for the design that design philosophies and criteria have been achieved; and

1.21.1.2 to provide an accurate record of the "As Constructed" services.

1.21.2 Information required for the checking function must be presented in ADAC format in accordance with Council's "Guidelines for Creation and Submission of ADAC XML Files".

1.21.3 The submission of digital "As Constructed" files in accordance with Council's ADAC guideline is mandatory in order to achieve acceptance of development works and commencement of the "Defects Liability" period and is required to be forwarded to Council a minimum of five working days prior to the "Works Acceptance" inspection or early plan sealing inspection for bonding of uncompleted works.

1.21.4 The following items must be submitted as part of the "As Constructed" submission:

1.21.4.1 electronic copies of the updated management plans, operational and maintenance manuals, and environmental management plans where these have been amended or not previously provided to Council (where applicable);

1.21.4.2 asset valuation report (detailed bill of quantities) in a format acceptable to Council and certified by an RPEQ;

1.21.4.3 an electronic copy of the Council approved final engineering drawings in both DWG and ADAC format together with electronic PDF copies;

1.21.4.4 where applicable, pump station RTU number and pump station identifier to be obtained from Council;

1.21.4.5 electronic copy of the Council approved landscaping and parks embellishment drawings;

1.21.4.6 electronic copy of Park/landscaping irrigation system drawings;

1.21.4.7 electronic copy of design plans for building/structure and copy of structural certificate;

1.21.4.8 "As Constructed" digital data and drawings of services and infrastructure including works completed by Council for the contractor under a Private Works agreement;
1.21.4.9 digital ground model data to the requirements of Council in an approved format (e.g. DWG or as nominated by Council).
1.21.4.10 Any necessary information required for Council's asset management records;
1.21.4.11 certificate of installed playground equipment to relevant Australian standards; and
1.21.4.12 details of works carried out on mains, whether or not they are part of the original project design or for a future stage.

CP 1.22 Compliance Certifications

1.22.1 All "As Constructed" works including the sewerage property connection branches, must be surveyed by a registered surveyor in order to obtain the detail required by Council's ADAC guideline. The registered surveyor's certification must accompany the "As Constructed" submission to Council. See Form 5 for an example of an acceptable Registered Surveyor's (Consulting) Certification.

1.22.2 All "As Constructed" works must also be certified by the consulting engineer responsible for the works. The certification must note that the design intent and function of the proposed works have not been compromised by the constructed works. To this extent, the consulting engineer will be responsible for determining whether the "As Constructed" details that exceed the tolerances for construction do not compromise the design intent and/or operational effectiveness of the infrastructure.

1.22.3 It is recognised that in some circumstances, the tolerances for construction are exceeded. In these instances, the consulting engineer will be responsible for performing confirmation design calculations to ensure that the original design intent and function are not compromised.

1.22.4 Further, should the "as constructed" details indicate a change to the design intent or function of the works, revised design calculations shall be provided by the consulting engineer to indicate the acceptability of the proposed change relative to Council's requirements. Council's approval of the change is required prior to the formal acceptance of the works.

1.22.5 The consulting engineer shall be responsible for the completion of Form 6 "Statement of Compliance - As Constructed Works".

CP 1.23 Management Plans, Operation and Maintenance Manuals

1.23.1 Where works comprise pump stations, reservoirs, treatment plants etc, operation and maintenance manuals for all components shall be provided. Operating and maintenance manuals shall include spare parts lists, electrical documentation and any other relevant information. Maintenance manuals and procedures are also required for drainage structures which incorporate Gross pollutant traps, interceptor devices etc. The maintenance procedures should indicate recommended frequencies for maintenance/planning functions in wet and dry seasons.

1.23.2 Management plans are necessary for where there is any future maintenance required to ensure sustainability of that feature, i.e. waterways, bio retention basins etc.

CP 1.24 Project Documentation

1.24.1 Development works will not be accepted until construction records have been certified as being completed by the consulting engineer and accepted by Council.

1.24.2 A complete copy of the following documents shall be provided to Council for acceptance prior to the "Works Acceptance" inspection:

- 1.24.2.1 ITP certified by the consulting engineer;
- 1.24.2.2 "Works Acceptance" inspection checklist;
- 1.24.2.3 "As Constructed" submission (including ADAC files) in accordance with CP1.21;
- 1.24.2.4 management plans, operation and maintenance manuals in accordance with CP 1.23;
- 1.24.2.5 water and sewerage inspection certificates including pump station and reservoir commissioning certificate; and
- 1.24.2.6 digital copy of CCTV survey for sewer and stormwater with engineering report and certification.

1.24.3 Copies of all test results required to confirm compliance with Council standard specifications shall be assembled and retained as part of the project documentation within the consulting engineers record storage facilities. Whilst not a complete listing, the following details some major records to be included:

- 1.24.3.1 fill compaction test results;
- 1.24.3.2 subgrade CBR's;
- 1.24.3.3 subgrade replacement material quality, thickness and locations;
- 1.24.3.4 subgrade replacement material compaction test results;
- 1.24.3.5 subsoil drain filter media quality statements (or grading is where required);
- 1.24.3.6 subbase course and base course material quality statements and thicknesses;
- 1.24.3.7 subbase course and base course compaction test results;
- 1.24.3.8 prime or primer spray seal and application rates;

1.24.3.9 AC core test results;
1.24.3.10 sewer pressure test records;
1.24.3.11 grading to sewer bedding quality statements;
1.24.3.12 grading to water main bedding quality statements;
1.24.3.13 water main pressure test records;
1.24.3.14 pump station commissioning and test certification by Council (sewer and water) including wet–well, pumps and switchboard;
1.24.3.15 any concrete testing required by the technical specifications;
1.24.3.16 pipework material quality statements for all pipework material (water, sewer, stormwater et cetera);
1.24.3.17 Geo fabric material quality statements;
1.24.3.18 digital copy of CCTV survey for sewer and stormwater with engineering report and certification;
1.24.3.19 any other testing results or statements required to conform with this manual;
1.24.3.20 any other job specific testing carried out ordered by the consulting engineer, if used.

1.24.4 The consultant should prepare a letter to Council requesting acceptance of a pump station for the purpose of achieving "Works Acceptance" for the subdivision. The letter should include/enclose:

1.24.4.1 the pump station allotment number, as it appears on the survey plan;
1.24.4.2 the name of the pump station and RTU number;
1.24.4.3 copy of approved design drawings;
1.24.4.4 copy of as – constructed drawings (can be preliminary);
1.24.4.5 copy of completed pre-commissioning checklist;
1.24.4.6 details of any nonconformances and uncompleted works;
1.24.4.7 rectification plan if required;
1.24.4.8 copy of ITP;
1.24.4.9 certification by the consultant for structural design, buoyancy and compliance with design drawings and this manual;
1.24.4.10 request that Council make application to Ergon for connection of power accompanied with a locality plan with street names showing the pump station location to attach to the application; and
1.24.4.11 evidence that an application for commissioning a sewerage pump station has been lodged.

1.24.5 The information to be provided to Council shall include as a minimum the requirements of the pump station commissioning checklist (Appendix H). The following pump station information shall also be provided to Council:

1.24.5.1 pump manufacturer, model, type, and impeller diameter (as a cut sheet);
1.24.5.2 rating of the motor;
1.24.5.3 weight of the pump and motor;
1.24.5.4 Manufacturers performance curve (as a cut sheet);
1.24.5.5 curves with at least four points plotted of the actual performance established in the field, or similar supervised work certificate plotted with the manufacturers pump curve;
1.24.5.6 KWH/1000 L pumped;
1.24.5.7 complete wiring diagrams and details (if not Council standard);

1.24.5.8 mechanical details and parts list of pump and motor;
1.24.5.9 maintenance catalogue showing also daily, weekly, monthly and annual maintenance requirements; and
1.24.5.10 a complete set of the manufacturers recommended spares delivered to Council.

1.24.6 Should any of the above test results fail to meet specification the consulting engineer shall include in the record, details of retesting/rectification carried out.

1.24.7 The construction record should be retained analogically assembled and bound document including a table of contents confirming completeness and presented to Council on completion of the works.

1.24.8 Site-specific as constructed drawings for pump stations and reservoirs. The drawings must be prepared in accordance with the requirements set out in Council's ADAC and Survey guidelines.

CP 1.25 "Works Acceptance" Inspection

1.25.1 The "Works Acceptance" inspection requires attendance by:
1.25.1.1 The consulting engineer for the project;
1.25.1.2 The contractor; and
1.25.1.3 Council's nominees.

1.25.2 It is the responsibility of the contractor and the consulting engineer to ensure any necessary requirements of the works are to an acceptable standard (as defined in approved design and construction documentation) prior to the conduct of a "Works Acceptance" inspection.

1.25.3 The general requirements to be met prior to Council's "Works Acceptance" inspection of the works are as follows:
1.25.3.1 the site is clean, tidy, free of rubbish, rocks, sticks, unauthorised stockpiles, etc.
1.25.3.2 allotment earthworks and site grading to be free draining and in accordance with the approved design;
1.25.3.3 integrity of environmentally significant areas is maintained;
1.25.3.4 all sewers flushed and gravity sewers inspected by CCTV; and
1.25.3.5 valve boxes and manhole tops visually located and not covered.

1.25.4 Prior to requesting a "Works Acceptance" inspection, the consulting engineer is responsible for confirming:
1.25.4.1 that the approved works have been completed;
1.25.4.2 any non-compliant issues or defects noted during the construction process, have been rectified to Council satisfaction;
1.25.4.3 the above listed items are in accordance with the approved drawings, Council's technical specifications and accepted engineering and landscaping practice; and
1.25.4.4 project documentation listed in CP 1.25 have been submitted. Failure to do so may result in cancellation of the inspection and/or the incurring of a reinspection fee.

1.25.5 Further to the above, and prior to the "Works Acceptance" inspection, the consulting engineer shall be responsible for the completion of the "Works acceptance" Inspection Checklist (Form 4) as appropriate to the works being constructed.

1.25.6 The completed checklist shall be presented to the relevant Council officer prior to the "Works Acceptance" inspection. Council officers will not undertake a detailed check of all items raised in the checklist but will examine some aspects of the works on an audit basis. The original of the completed checklist shall be retained with the records for the project upon completion of the works.

CP 1.26 Bonding of Uncompleted Works

1.26.1 For subdivision works council may, at its discretion, approve the bonding of uncompleted works to enable early sealing of survey plans. If Council does consent to the early sealing of survey plans, the developer must disclose to prospective purchasers that all services may not be available until the outstanding works are completed. Council will only consider early plan sealing for the full stage of the development is defined in the Operational Works approval. Parts of a stage will not be considered for early plan sealing.

1.26.2 Prior to the submission of any bond or plans for sealing, the following matters must be completed to the satisfaction of Council:

- 1.26.2.1 engineering plans have been approved; and
- 1.26.2.2 all survey pegs placed;
- 1.26.2.3 all allotment preparation work and earthworks on allotments have been completed in accordance with the requirements of this manual, with finished surface levels, the degree of compaction achieved and geotechnical assessments required on any of the allotment submitted and approved by Council.
- 1.26.2.4 Roads have been constructed to subbase level;
- 1.26.2.5 all stormwater systems including kerb and channel constructed;
- 1.26.2.6 sewer systems to be installed, tested, operational and "as constructed" plans lodged and accepted;
- 1.26.2.7 water supply system to be installed, tested, commissioned and "as constructed" plans lodged an accepted;
- 1.26.2.8 satisfactory evidence is to be provided to Council of a negotiated agreement with service providers for telecommunications, cabling, reticulation of electricity and the provision of street lighting and gas service providers for provision of gas (if applicable);
- 1.26.2.9 all outstanding rates are paid;
- 1.26.2.10 all works within allotments are fully completed and no further disturbance required on the allotments;
- 1.26.2.11 appropriate erosion and sediment control measures are in place for all disturbed areas;
- 1.26.2.12 all other bonded works (or works under agreement) are included in a bona fide contract between the developer and the contractor to be completed within 90 days;

1.26.2.13 all contributions required by the conditions of approval shall be paid prior to sealing of survey plans (infrastructure charges, contributions to service providers, Department of Main roads contributions, etc).

1.26.2.14 "As constructed" information provided for all completed works and accepted by Council;

1.26.2.15 submission of CCTV survey of completed sewers and stormwater drainage systems; and

1.26.2.16 building approval for all buildings/structures.

1.26.3 When the above matters have been completed, the applicant or consulting engineer shall submit the following to Council:

1.26.3.1 Security lodgement Form (Form 2) to be completed clearly indicating that the purpose of the bond is for uncompleted works;

1.26.3.2 fully priced schedule of outstanding works including the cost of preparation of the "as constructed" submission;

1.26.3.3 cash bond or unconditional bank guarantee to the value of 1.5 times the estimated value of the uncompleted works as certified by the consulting engineer. A bank guarantee should include:

1.26.3.3.1 a binding contractual relationship between counsel and the guaranteeing bank;

1.26.3.3.2 specific requirements for renunciation of the guarantee; and

1.26.3.3.3 require adequate notice of renunciation and must not have an expiry date.

1.26.3.4 certification from the consulting engineer that the works on each allotment have reached a stage acceptable to Council and that the outstanding works are programmed for completion within 90 days. The outstanding construction works program must be Council approved;

1.26.3.5 all bonds submitted shall be clearly identified as to the particulars of the site and the purpose of the bond.

1.26.3.6 Council may, at its discretion, require an Uncompleted Works inspection to ensure that the on allotment works and all associated documentation has been completed to Council's satisfaction. Should an inspection be deemed necessary, Council will require five (5) days' notice and payment of the required inspection fee in advance of any inspection.

CP 1.27 Sealing of Plan of Survey

1.27.1 Where operational works are associated with the reconfiguration of land or creation of new titles the Applicant is required to submit plan of survey which accords with the proposal plan approved by Council, suitable for deposit in the office of the Registrar of Titles and duly certified by a Registered Surveyor (Consulting Cadastral), together with 4 copies of the plan, and a completed application form for sealing of survey plans, building units, or group titles plan within 2 years from the date of approval of engineering drawings and specifications for subdivisions involving works.

1.27.2 Where the survey plans differ from the approved proposed plan, details of any changes are to be provided with the application.

1.27.3 The application form and plans, certificate(s) of compliance for any water, sewer reticulation and stormwater drainage system (including CCTV survey), together with the relevant fee are to be lodged with Council.

1.27.4 Upon being satisfied that the Plan of Survey conforms with the approval granted, and all required works have been carried out, or adequate security in accordance with Council's policy for bonding of uncompleted works is provided and all outstanding rates, contributions and charges have been paid, Council will note its approval under seal on the plan of survey and return the plan of survey to the Applicant for lodgement in the Titles Office.

1.27.5 The Applicant is required to submit the plan of survey to the Titles Office within 6 months of Council sealing the plan. Failure to do so will require the plan of survey to be resubmitted to Council for resealing.

Final Acceptance of Works

CP 1.28 “Final Acceptance” Inspection General Requirements

1.28.1 The “Final Acceptance” inspection will generally confirm the matters raised in the “Final Acceptance” inspection checklist (Form 4) and any other matters outstanding relevant to the works. The checklist is to be completed by the consulting engineer prior to the conduct of the “Final Acceptance” inspection. Failure to do so may result in cancellation of the inspection and/or the incurring of a reinspection fee.

1.28.2 During the defects liability period, it is the responsibility of the developer to rectify any works found to be defective or found to exhibit faults attributed to the design of the works and/or the performance of the construction activities in terms of quality and conformance with the design and specifications.

1.28.3 Once a period of 12 months minimum (or other such period as determined by Council) has elapsed from Council’s acceptance of the works “Works Acceptance”, a “Final Acceptance” inspection is to be arranged with Council. Payment of an appropriate inspection fee may be required.

1.28.4 The “Final Acceptance” inspection is to be attended by:

1.28.4.1 Council’s nominees;

1.28.4.2 the consulting engineer for the project; and

1.28.4.3 the contractor.

1.28.5 The consulting engineer for the work shall be responsible for ensuring that Council’s requirements for acceptance of the works are satisfied prior to requesting a final acceptance inspection.

1.28.6 Council’s requirements for final acceptance of the works are:

1.28.6.1 No outstanding payments are due to Council or other Authorities from the development;

1.28.6.2 completion of the “Final Acceptance” inspection checklist;

1.28.6.3 satisfactory “Final Acceptance” inspection;

1.28.6.4 All conditions of the approvals for as constructed drawings, works acceptance and plan sealing have been completed to the satisfaction of Council.

1.28.7 Following a satisfactory Final Acceptance inspection, the consulting engineer shall submit a written request to Council for Final Acceptance of the works and release of the defects liability bond. Council will, upon confirmation that no outstanding payments arising from the development are due to Council, confirm acceptance of the works, and arrange for the release of the defects liability bond.

DP 1 – DEVELOPMENT PRINCIPLES

General

DP 1.01 Introduction

1.01.1 This section of the Development Manual has been prepared to provide guidance on the design principles and issues to be considered by the designer in the preparation of layout plans for new urban developments. It is to be read in conjunction with the relevant planning scheme, and any local laws and policies.

DP 1.02 Urban Development Objectives

1.02.1 In addition to the requirements of the relevant planning scheme, local laws and policies, urban development layouts should:
- 1.02.1.1 Protect and enhance environmentally significant areas;
- 1.02.1.2 Be sympathetic to the existing topography and landform;
- 1.02.1.3 Minimise the impacts on the surrounding environment;
- 1.02.1.4 Facilitate the provision of urban services; and
- 1.02.1.5 Provide a safe urban living environment.

DP 1.03 Identification of Site Constraints and Values

1.03.1 In preparing an urban development layout, it is important to identify the natural constraints and values of the site and any engineering constraints on the provision of urban services and amenities.

1.03.2 Factors that may impose constraints on the development layout include but are not limited to:
- 1.03.2.1 Existing significant vegetation;
- 1.03.2.2 road and service connections to adjoining properties;
- 1.03.2.3 public transport networks;
- 1.03.2.4 railway and cane tram way lines;
- 1.03.2.5 external stormwater drainage catchments;
- 1.03.2.6 downstream stormwater drainage and receiving waters;
- 1.03.2.7 low-lying areas subject to flooding and ponding;
- 1.03.2.8 constraints and impact on adjoining properties;
- 1.03.2.9 constraints and limitation of existing utility services and planned augmentation works;
- 1.03.2.10 Main roads resumption requirements;

1.03.2.11 existing topographical features;
1.03.2.12 water quality issues; and
1.03.2.13 geotechnical considerations.

1.03.3 Designers are encouraged to consult with Council and other relevant authorities prior to or during the preparation of the site layout and design concept. Designers should in addition to the requirements of this manual ascertain any specific requirements of these authorities as they relate to the designs in hand.

DP 1.04 Vegetation Protection and Environmentally Significant Areas

1.04.1 Prior to preparing a development layout, all areas that have significant environmental value should be identified and incorporated into the layout design to enable them to be preserved and protected. Any disturbances within these areas shall be minimised to the satisfaction of Council and other relevant authorities, as may be appropriate.

1.04.2 All existing natural streams, watercourse and riparian vegetation shall be preserved. To minimise the impacts on stream bank vegetation, all streams and watercourses shall be protected by a drainage reserve. The extent of the drainage reserve shall be determined by the following criteria:

1.04.2.1 Not less than 3m clear of tree trunks of adjacent trees;
1.04.2.2 Not less that 10m clear of the high bank of the adjacent drainage path;
1.04.2.3 Not less than 20m clear of the high bank of a perennial stream;
1.04.2.4 Clear of the ARI 100 year storm event influence from the adjacent drainage path; and
1.04.2.5 Clear of the vertical projection of the tree canopy of the adjacent trees.

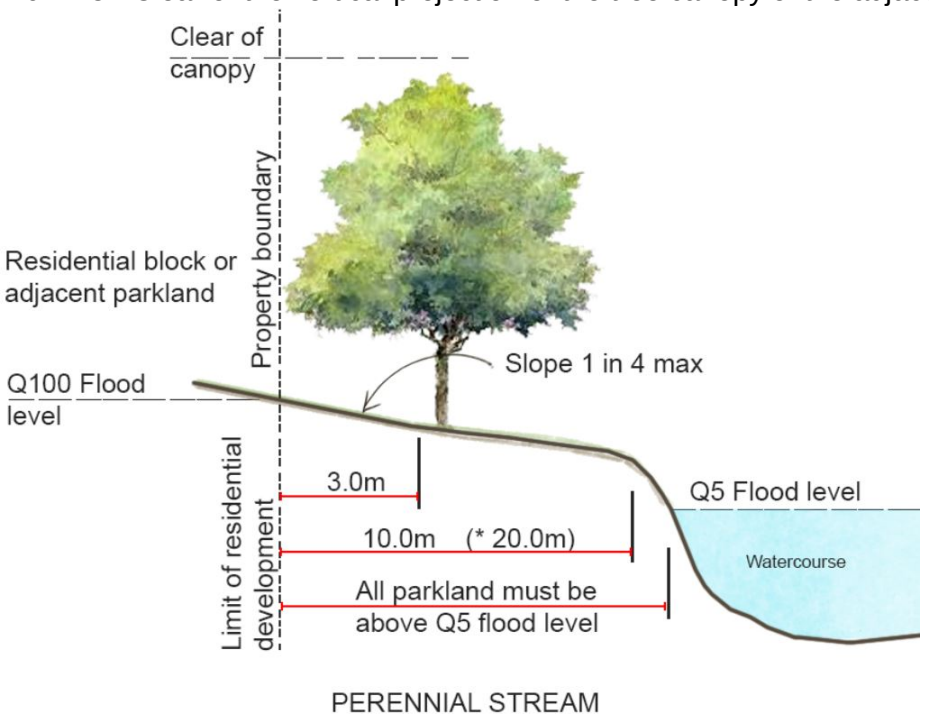


Figure DP1.1 Limits of development adjacent to natural stream banks

1.04.3 In order to retain any established landscape character, all trees located within existing road reserves shall be protected and retained unless approved otherwise by Council.

1.04.4 Reference should be made to the Vegetation Management Act and any Local Laws and Policies to ascertain any requirements in relation to tree clearing.

DP 1.05 Crime Prevention Through Environmental Design

1.05.1 It is important when designing development layouts that the principles of crime prevention through environmental design are considered, in particular:

1.05.1.1 Natural surveillance of public open spaces is optimised; and

1.05.1.2 Long pathway or obscured park areas that remain unlit should be avoided.

Engineering Issues

DP 1.06 General

1.06.1 The optimum site and road layout needs to be developed through consideration of social, environmental, town planning, traffic and engineering issues.

1.06.2 Although the engineering design of roads is the province of the engineer, it is essential that the surveyor and planner preparing the site layout the fully aware of the engineering issues to ensure that the road layouts proposed are satisfactory in this regard. Major alterations to the development layout may otherwise be necessary to accommodate engineering requirements.

1.06.3 The factors to be taken into consideration when designing new development layouts include the following:

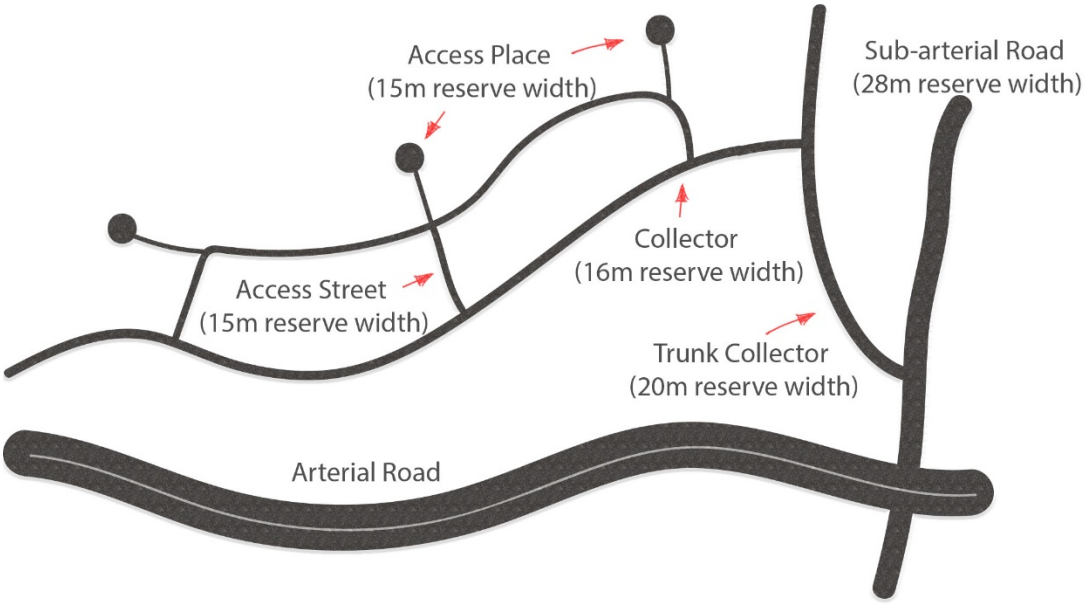
1.06.3.1 Proposed land use;
1.06.3.2 Road hierarchy, interim and ultimate;
1.06.3.3 Public transport network;
1.06.3.4 Local planning policies, bikeways/paths and open space;
1.06.3.5 Council's drainage management plans;
1.06.3.6 Council's traffic management plans;
1.06.3.7 Railway and cane tram way lines;
1.06.3.8 access requirements for service vehicles and emergency vehicles;
1.06.3.9 topography of the area;
1.06.3.10 adequate road frontage to parks and drainage reserves;
1.06.3.11 existing utility services constraints and proposed augmentation works;
1.06.3.12 crime prevention through environmental design;
1.06.3.13 impacts on adjoining properties;
1.06.3.14 existing stormwater drainage;
1.06.3.15 flooding and ponding;
1.06.3.16 preservation of natural watercourses;

1.06.3.17 significant existing vegetation;
1.06.3.18 bushfire protection measures;
1.06.3.19 impact of earthworks;
1.06.3.20 water quality improvement structures and features;
1.06.3.21 existing soil conditions; and
1.06.3.22 geotechnical considerations.

DP 1.07 Road Network

1.07.1 The provision of a Road network within a subdivision development is to be designed to achieve the following aims:
- 1.07.1.1 convenient and safe access to all allotments for pedestrians, vehicles and cyclists;
- 1.07.1.2 safe, logical and hierarchical transport linkages with existing Street system;
- 1.07.1.3 appropriate access for buses, emergency and service vehicles;
- 1.07.1.4 convenient service corridors for public utilities;
- 1.07.1.5 opportunity for street landscaping; and
- 1.07.1.6 convenient parking for visitors.

1.07.2 A hierarchical Road network is essential to maximise Road safety, residential amenity and legibility. Each class of Road in the network serves a distinct set of functions and is designed accordingly. Atypical hierarchy is shown below.



1.07.3 The maximum number of turning movements at intersections or junctions that a visitor should be required to undertake to reach a particular address within the development should be minimised.

1.07.4 The road network should be designed to ensure that roads connect to next order of road in the hierarchy. Under no circumstances should a road connect to another road, which is more than two, levels higher or lower in the hierarchy.

1.07.5 Where an Access Place forms part of a pedestrian or cycle network, suitable connectivity with adjoining Access Places or open space systems should be provided to ensure such pedestrian and cycle network are functionally efficient.

1.07.6 Developments layouts should be designed with a road layout to achieve the desired speed environment. The use of traffic control devices in lieu of a suitable road layout is not preferred.

1.07.7 It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that no more than 10 per cent of residents should have to walk in excess of 500 metres to catch a bus. Normally roads above the Access Street in the hierarchy are designed as bus routes.

DP 1.08 Site Regrading Concept

1.08.1 Excessive site regrading should be avoided, wherever possible site layouts should be developed to position roads and drainage networks to take advantage of natural surface grades. Site layouts that minimise the disturbance of the land will require less erosion and sediment control measures during construction phase and reduce the risk of environmental harm.

1.08.2 Where earthworks are proposed on any development site identified in the Whitsunday Regional Council Planning Scheme Landslide Overlay as having a gradient of 15% or greater input should be sought from a qualified geotechnical engineer to ascertain slope stability and potential construction issues.

DP 1.09 Stormwater Drainage

1.09.1 The design of the drainage system, and earthworks for the proposed development shall be such that the upstream drainage is not adversely affected and that the downstream drainage system is capable of adequately catering for the discharge of the additional flow produced as a result of the development.

1.09.2 If the downstream system is not capable of carrying the modified discharge, the designer shall indicate the measures proposed to ensure the downstream system is capable of carrying the modified discharge. This will involve negotiation with adjoining landowners for minor creek systems to produce easements over downstream drainage paths. Written approval from the respective property owners is required for the easement and any engineering works on their property from the development site to the legal point of discharge.

1.09.3 The development layout shall be designed to accommodate both existing and future developed flows from upstream catchments based on development in accordance with the relevant Planning Scheme.

1.09.4 In preparing a development layout, consideration should be given of the overall site drainage philosophy, and overland flow paths, to ensure that the road network has sufficient drainage capacity to safely convey stormwater runoff to its receiving waters with minimal nuisance or damage to the community.

1.09.5 Consideration should be given in the preparation of the layout to ensure that in the event of drainage system failure, adequate emergency relief paths are provided. In particular, downhill sloping cul-de-sac heads should be avoided where a sufficient width pathway or open space cannot be provided to convey the overland flow.

DP 1.10 Stormwater Quality Management

1.10.1 In recognition of the impacts that development may have on the quality of water within the waterways, the over-riding objective for water quality management is to minimize the potential for development activity to cause harm to the environment / receiving waters.

1.10.2 All developments are required to include appropriate SQID's that ensure removal of suspended matter (litter) and treatment of contaminated stormwater prior to crossing the boundary of the development or discharge into downstream roadside gutters, stormwater drainage systems or waterways.

1.10.3 The location of the interception devices within the drainage system is to be planned to ensure that the first flush waters from all parts of the site are treated and they can be easily accessed for cleaning and maintenance.

DP 1.11 Sewerage Reticulation

1.11.1 In preparing a development layout, consideration should be given to the provision of sewerage reticulation connections to adjoining properties based on their future development in accordance with Council's Strategic Plan.

1.11.2 Where an existing sewerage reticulation line pass through a development site, the development layout should where possible incorporate the sewer with the development layout. Where this is not practical the layout should be prepared to minimise the extent of the sewerage relocation work necessary.

DP 1.12 Electricity Supply and Telecommunication Services

1.12.1 In preparing a development layout, the relevant Service Authorities should be consulted to confirm that the provision of services to the proposed development would be provided and if the provision of land for the purpose of siting infrastructure would be necessary.

DP 1.13 Tramlines through Urban Areas

1.13.1 Where cane tramlines run through urban areas a tramway reserve shall be created over tramline and transferred to Council.

1.13.2 The width of the tramway reserve for a single line shall be a minimum of twelve (12) metres. The reserve should be centrally located around the tramline except where exceptional circumstances prevent this. (e.g. adjoining tramway easement or reserve is placed off centre).

1.13.3 Under certain embankment / cutting conditions it may be necessary to widen the easement to provide a 3.0m wide access to at least one side of the track.

1.13.4 Where multiple tracks exist, the tramway reserve shall include all tracks plus a distance of six (6) metres from the centreline of the outermost tracks on each side.

1.13.5 This widened section shall be continued past the point of convergence of the tracks (i.e. the point of the switch of the first turnout of single line) a minimum of twenty (20) metres before becoming a standard twelve (12) metre easement again.

1.13.6 Residential areas should be sited away from siding locations if at all possible because of major dust and noise pollution problems. For cases where development will adjoin siding locations (closer than one hundred (100) metres from any part of the planned subdivision to the cane unloading point) then each such location would need to be the subject of a special study between the developer, the appointed consultants, representatives of the Mill and Council, in order to identify the unique problems of the location.

1.13.7 The number of road crossings should be kept to a minimum. Factors affecting the positioning of road crossings include: sight distances, track grades, proximity of the nearest crossing and the noise problem associated with the use of the train whistle at close successive crossings. Of particular importance is the adjacent grading of the track. The locating of road crossings on or near the base of falling grades should be avoided. Any road crossing proposal must be submitted to the Mill for the assessment of its likely implications on its own operations and on road users and residents.

DG1 - DESIGN GUIDELINES – ROAD GEOMETRY

Scope & Aims

DG 1.01 Road Geometry

1.01.1 This section sets out the minimum standards developed specifically for the design of roadworks using principles of Street design to enable safety and improved amenity and to reduce pedestrian/vehicular conflicts.

1.01.2 The geometry of a road is to be designed to achieve the following aims:

1.01.2.1 provide convenient and safe access to all allotments for pedestrians, vehicles and cyclists;
1.01.2.2 provide appropriate access for buses, emergency and service vehicles;
1.01.2.3 provide a convenient verge for public utilities;
1.01.2.4 provide an opportunity for street landscaping; and
1.01.2.5 provide convenient parking for visitors.

DG 1.02 Reference Documents

1.02.1 Australian Standards:
1.02.1.1 AS1158 Lighting for Roads and Public Spaces;
1.02.1.2 AS1348.1 Road and Traffic Engineering – Glossary of Terms, Road Design and Construction;
1.02.1.3 AS1428 Design for Access & Mobility;
1.02.1.4 AS2890.1 Parking Facilities: Off-street parking;
1.02.1.5 AS2890.2 Parking Facilities: Off-street Commercial Vehicle Facilities;
1.02.1.6 AS2890.5 Parking Facilities: On-street Car Parking;
1.02.1.7 AS/NZS 3845 Road Safety Barrier Systems;
1.02.1.8 AS 4678 Earth retaining structures
1.02.1.9 AS4282 Obtrusive Effects of Outdoor Lighting.
1.02.1.10 Disability Standards for Accessible Public Transport – IPWEAQ
1.02.2 Department of Transport & Main Roads:
1.02.2.1 Road Planning & Design Manual;
1.02.2.2 MUTCD;
1.02.2.3 Transport Operations (Road Use Management) Act.
1.02.3 Austroads:
1.02.3.1 Guide to Road Design;
1.02.3.2 Guide to Traffic Management
1.02.3.3 Guide to Road Safety;
1.02.3.4 Cycling Guidelines;
1.02.4 Other:
1.02.4.1 IPWEAQ Complete Streets;
1.02.4.2 Australian Model Code for Residential Development.

DG 1.03 Consultation

1.03.1 Designers are encouraged to consult with the Council and other relevant authorities prior to or during the preparation of the design. Designers should in addition to requirements of this manual ascertained specific requirements of these authorities as they relate to the designs in hand.

Road Design Criteria

DG 1.04 Design Speed

1.04.1 For geometric design of roads, design speeds shall be as nominated in Table D1.1 unless specified otherwise by Council. Developments should be designed with a road layout to achieve the desired speed environment. The use of Traffic Control Devices in lieu of a suitable road layout is not preferred.

1.04.2 Adoption of a low design speed discourages speeding, attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.

1.04.3 Design speeds shall be calculated on largest radius track between kerb and centreline unless a physical constraint is incorporated in the design to maintain vehicle tracking in traffic lane.

DG 1.05 Longitudinal Gradient

1.05.1 A general minimum gradient of 0.5% should be adopted for all roads, which will ultimately include kerb and channel. In very flat conditions where approved by Council it may be reduced to 0.3%.

1.05.2 A desirable minimum gradient of 1.0% should be adopted for all roads, which will have earth table drains, except where approved otherwise by Council, in exceptional cases.

1.05.3 Roads constructed, without kerb and channel, completely in embankment may have zero grade.

1.05.4 Maximum grades shall be as nominated in Table D1.1.

1.05.5 Longitudinal grade 3 intersections should not exceed 4%, the actual gradients being dependent on the type of terrain. Design of the road alignment and the grades used are interrelated. A steep grade on a side street is undesirable if vehicles must stand waiting for traffic on the priority road.

1.05.6 Turning circles and cul-de-sacs on steep grades should have grades less than 5%.

1.05.7 Where minimum radius crest vertical curves are used local widening is to be provided to facilitate safe ingress/egress from properties.

DG 1.06 Horizontal Alignment

1.06.1 Horizontal alignment shall generally comply with the requirements of Austroads, Complete Streets, or Department of Transport and Main Roads manuals, as applicable.

1.06.2 Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers can safely negotiate the curve. Curves that progressively tighten produce an uncomfortable sense of disorientation and alarm. Sudden reverse curves that drivers cannot anticipate also have a potential to cause similar conditions.

1.06.3 The horizontal alignment shall ensure adequate sight distances taking into account construction of solid fencing on property boundaries.

DG 1.07 Vertical Curves

1.07.1 Vertical curves should be used on all changes of grade where the algebraic change of grade exceeds:

1.07.1.1 Access Place, Access Street, Collector Street – 1%

1.07.1.2 Trunk Collector Streets – 0.6%

1.07.2 The length of the crest vertical curve for stopping site distance should conform to Austroads;

1.07.3 for adequate riding comfort, lengths of stag vertical curves should conform to Austroads;

1.07.4 Every effort should be made to provide vertical curves as long as possible, for improved appearance.

1.07.5 Drainage poses a practical limit to the length of stag curves and a maximum length (in metres) 15 times the algebraic some of the intersection vertical grades should be adopted. This is to avoid water ponding in excessively flat sections of curb and channel. A minimum grade of 0.5% should be maintained in the curb and channel.

1.07.6 In general, a minimum 10 m length vertical curve shall be provided with a side road joins the through road at three-way intersections.

1.07.7 A tangent point of a vertical curve in the side road shall be located at, or outside of, the kerb line of the through road. Council may approve the use of concrete invert in lieu of a vertical curve with a side road is at Access Place and the algebraic change of grade is less than 6%.

1.07.8 The three-dimensional coordination of the horizontal and vertical alignment of a road should be aimed at improving traffic safety and aesthetics. The following principles should be applied:

1.07.8.1 The design speed of the road in both horizontal and vertical planes should be of the same order;

1.07.8.2 Combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally;

1.07.8.3 Sharp horizontal curves shall not be introduced at or near the crest of a vertical curve;

1.07.8.4 Horizontal curves should leave the vertical curve and be longer than the vertical curve; and

1.07.8.5 A short vertical curve on a long horizontal curve or a short tangent in the grade line between sag curves may adversely affect the road's symmetry and appearance.

DG 1.08 Crossfalls

1.08.1 Carriageway crossfalls for streets shall conform to the requirements of Austroads and/or Complete Streets.

1.08.2 Generally, pavement crossfalls on straight roads shall be:

- 1.08.2.1 Bituminous seal coat - 3%
- 1.08.2.2 Asphaltic concrete pavement – 3%
- 1.08.2.3 Cement concrete pavement – 3%
- 1.08.2.4 Paved Surfaces – 3%
- 1.08.2.5 Gravel – 5%.

1.08.3 Median crossfalls - the maximum crossfall on grassed medians on divided roads shall be desirably 1 in 6 with an absolute maximum of 1 in 4. Refer also Department of Transport and Main Roads Design Manuals. However, at median openings, the pavement crossfall should not exceed 5 per cent.

1.08.4 For roundabouts detailed consideration of the crossfall is required taking into account diameter, heavy vehicle turning, etc.

Table D1.1 WRC Street and Road Hierarchy – Deemed to Comply Requirements

Roadway Classification	No. of Dwellings	Traffic Generation (vehicles per day)	Reserve Width[1] (Minimum)	Carriageway Width [3,6] (Minimum)	Shoulder Width (Minimum)	Verge Width (each side) (Minimum)	Max Grade (Desirable) %	Design speed (km/h)
Access Place	0-10	0-99	14	6.0m		4.0m	(12) 16 [4]	40
Access Street	10-25	100-499	15	6.0m		4.5m	(12) 16 [4]	50
Collector Street	25-299	500-2,999	20	7.5m		5.0m	(8) 10	60
Trunk Collector Street	300-599	3,000-5,999	24	10.0m	1.5m (min)	5.0m	(8) 10	60
Sub Arterial Road	600-2,000	6,000-20,000	26	2 x 5.5m carriageway 5.0m median		5.0m	(6) 8	60
Rural	Refer table D1.4 for details of Rural Road Elements							
Arterial and Major Arterial	The requirements for these categories shall be provided by the Council or relevant authority (DTMR). Traffic volumes shall be identified in a traffic management report.							
Industrial Access	-	-	20	12m		4m	(6) 10	60
Industrial Collector	<30ha	-	22	14m		4m	(6) 8	50

1. Carriageway (and reserve) widening shall be provided on bends in accordance with Austroads.
2. Widening of carriageway to 10m shall be required on all bus routes, and a minimum road reserve of 18m provided.
3. Carriageway widths are measured from the invert of the kerb and channel on one side of the carriageway to the invert of the kerb and channel on the opposite site of the carriageway.
4. The absolute maximum grade shall be 20% for a maximum length of 60m. The maximum length of grades less than 20%, but not less than 16%, shall be 60m plus 25m for each 1% the grade is less than 20%. The maximum length of any grade greater than 16% shall be 160m.
5. Road reserve widths may require widening to accommodate table drains, provision for services, on-street car parking provision and bus bays.
6. Minimum reserve must be provided, irrespective of minimum verge and carriageway widths specified.
7. Where the road is nominated as part of the bikeway network, allowance for bike lanes shall be added to this width (minimum bikeway width is 1.5m or 2.0m where the design speed is >60km/h).
8. Refer to Council's standard drawings.

DG 1.09 Carriageway Width

1.09.1 Minimum carriageway widths for all streets shall be as nominated in Table D1 .1.

1.09.2 The carriageway widths must allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway. Vehicles include tracks, emergency vehicles and, on some roads, buses.

1.09.3 The safety of pedestrians and cyclists where it is intended that they use the carriageway must also be assured by providing sufficient width and visibility.

1.09.4 The carriageway which should also provide for unobstructed access to individual allotments. Motorists should be able to comfortably enter or reverse from an allotment in a single movement, taking into consideration the possibility of a vehicle being parked in the carriageway opposite the driveway.

1.09.5 The design of the carriageway should discourage motorists from travelling above the intended speed by reflecting the functions of the road in the network. In particular, the width and horizontal and vertical alignment should not be conducive to excessive speeds.

1.09.6 Appropriate road reserve width should be provided to enable the safe location, construction and maintenance of required paths and public utility services (above or below ground) and to accommodate the desired level of streetscape.

1.09.7 Where a “split-level” road is proposed, a stable form of retaining structures such as reinforced concrete, crib block, gabion or masonry walling (or other approved alternative) is required between upper and lower road levels.

1.09.8 Traffic islands shall be designed in accordance with the current DTMR or AUSTROADS design manuals.

1.09.9 Where upgrades are required the applicant may undertake a traffic count to confirm the number of vehicle movement per day on the subject road.

DG 1.10 Verges

1.10.1 Minimum verge width for all streets shall be as nominated in Table D1 .1.

1.10.2 A suitable design of the verge will depend on utility services, access to allotments, pedestrian usage, tree preservation and storm water drainage.

1.10.3 All verges shall fall from the frontage property boundary to the adjacent kerb and channel with acceptable Cross falls of between 3% to 5%. In the case where the allotment falls away from the road reserve (i.e. the allotment is lower than the level of the road), the verge shall have a minimum fall from the frontage property boundary to the adjacent kerb of 3%.

1.10.4 The maximum slope permissible within a road verge is 1 in 4.

1.10.5 The verge when considered in conjunction with the horizontal alignment and permitted fence and property frontage treatments should provide appropriate

sight distances, taking into account expected speeds and pedestrian and cyclist movements.

1.10.6 Utility service locations shall be in accordance with the relevant authorities' requirements.

1.10.7 Verges shall be covered full width with topsoil to a depth of not less than 40 mm and shall be lightly compacted and grassed in accordance with Council's minimum standards and specifications.

DG 1.11 Intersections

1.11.1 All new intersections of Access Places, Access Streets and Collector Streets, shall be three-way intersections designed and located in accordance with Austroads.

1.11.2 A roundabout shall be used in the design of four way intersections.

1.11.3 Intersections of Trunk Collector, Industrial, and Sub Arterial roads shall be designed in accordance with AUSTROADS design manual and shall allow for potential improvement to incorporate other traffic control methods e.g. traffic signals.

1.11.4 Intersections with state-controlled roads shall be designed and constructed in accordance with the requirements of DTMR.

1.11.5 The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes shall be used in designing all intersections or junctions on trunk collector streets or higher order roads.

1.11.6 Truncations shall be provided to real property boundaries in order to maintain minimum verge widths and adequate sight distances taking into account potential for construction of solid fencing on the property boundaries.

1.11.7 The turning radii at intersections measured at the kerb invert shall be 9.0m minimum and accommodate the intended movements without allowing desired speeds to be exceeded.

1.11.8 All vehicle turning movements are accommodated using AUSTROADS design vehicle and turning templates, as follows:

- 1.11.8.1 For turning movements involving trunk collector streets or collector streets, the "design semitrailer" with turning path radius of 15 m.
- 1.11.8.2 For turning movements involving access streets but not involving collector streets, the "design single unit track/bus" with turning path radius of 13 m.
- 1.11.8.3 For turning movements and access places but not involving collector streets or access streets the garbage collection vehicle with turning path radius of 12 m.
- 1.11.8.4 For turning movements at the head of cul-de-sacs for all streets, except access place, have sufficient area provided for the "design single unit track"; and
- 1.11.8.5 Road furniture shall be located to allow for clear manoeuvring of the design semitrailer.

1.11.9 Intersection channelisation is to be provided and designed in accordance with the current DTMR or AUSTROADS design manuals.

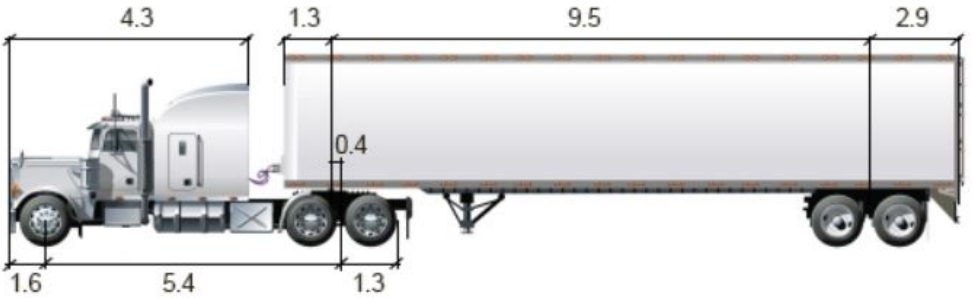
1.11.10 All channelisation shall be designed to accommodate a design vehicle providing a clearance of not less than 0.6 m between the wheel track and the kerbs at all points, unless specified otherwise by Council.

1.11.11 Traffic islands or medians of less than 2m width to be hard surfaced in concrete with a patterned broomed finish incorporating a coloured pigment in accordance with Council's requirements. This colour should generally be terracotta unless otherwise approved by Council.

1.11.12 Traffic islands, which are to be grassed or landscaped, shall be provided with a water service conduit and a perimeter subsoil drainage line connected to the underground drainage system or an open drainage channel.

1.11.13 On Trunk Collectors, Sub-Arterial and Arterial roads, median breaks will only be permitted at approved intersections.

1.11.14 Pavement markings associated with channelisation and signs shall be provided in accordance with the MUTCD.

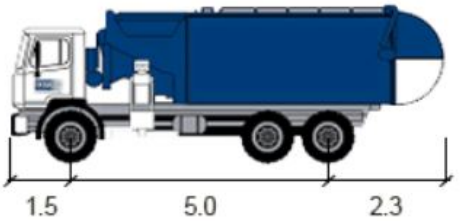


Semi-trailer

Tractor width	:	2.50	Trailer width	:	2.50
Tractor track	:	2.50	Trailer track	:	2.50
Turning radius (outside):		15.00			

Single unit truck/bus

Width	:	2.50
Track	:	2.50
Turning radius (outside):		13.00



Garbage truck

Width	:	2.50
Track	:	2.50
Turning radius (outside):		12.00

Figure 1.3 Standard Vehicles

DG 1.12 Roundabouts

1.12.1 Design of roundabouts will generally be in accordance with current Department of Transport and Main Roads Design Manuals and AUSTROADS Guide to Road Design.

1.12.2 Roundabout shall only be used at intersection of Collector Streets and Access Streets or higher order roads only. All roundabouts shall have a minimum inscribed circle diameter of 30.0m.

1.12.3 Centre islands which are to be grassed or landscaped shall be provided with a water service conduit and a perimeter subsoil drainage line connected to the underground drainage system or an open drainage channel.

1.12.4 Landscaping to centre islands to be in accordance with Council minimum standards and Specifications.

1.12.5 Roundabouts shall include provision for on road cycle lanes unless alternate cycle paths are provided.

DG 1.13 Cul-De-Sac Turning Areas

1.13.1 The turning areas at the ends of the cul-de-sac in streets is to be designed in accordance with Austroads and/or Complete Streets, excepting as follows:

1.13.1.1 Three-point turns (T-Heads) will not be permitted without the prior consent of Council. Council may review site specific alternatives where topography and site constraints exist.

1.13.1.2 Where a full turning circle is not provided to the minimum radius below, provision for turning within kerbs for Council's design garbage truck must be demonstrated.

1.13.2 Where a full turning circle is provided the minimum kerb radii shall be:

1.13.2.1 Approach and departure curves – 15m

1.13.2.2 The turning circle – 10m.

1.13.3 Turning areas at the ends of cul-de-sac in industrial developments shall be full turning circles based on criteria for the specific application, with the following minimum kerb radii:

1.13.3.1 Approach and departure curves – 30m

1.13.3.2 The turning circle – 15m.

1.13.4 All turning heads shall have adequate provision for on-street parking at cul-de-sacs in accordance with Austroads and/or Complete Streets. Provision of parking areas within the verge must not compromise the future connection of services to the allotments.

1.13.5 Reference should be made to table D3.2 for rural cul-de-sac requirements.

DG 1.14 Local Area Traffic Management

1.15.1 The road network should be designed to manage the movement and speed of traffic in local areas. In this regard, any traffic management devices such as thresholds, slow points, speed humps, chicanes and splitter islands should be designed in accordance with the requirements of AUSTROADS and are to be approved by Council.

1.15.2 Devices other than at intersections should be located to be generally consistent with streetscape requirements, existing street lighting, drainage pits, driveways, and services may decide the exact location of devices.

1.15.3 Emergency vehicles must be able to reach all residences and properties.

1.15.4 Where bus routes are involved, buses should be able to pass without mounting kerbs and with minimised discomfort to passengers.

1.15.5 Traffic management devices and associated road furniture must not prevent the passage of larger vehicles (i.e. semi-trailers) however their principle function is not to be compromised.

1.15.6 In newly developing areas where street systems are being developed in line with LATM principles, building construction traffic must be catered for.

1.15.7 Maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings have only minor effects on average speeds, and usually little or no effect on maximum speeds.

1.15.8 Speed reduction can be achieved using devices, which shift vehicle paths laterally (slow points, roundabouts, corners). The use of vertical devices (i.e. humps, platform intersections, platform pedestrian/school/bicycle crossings) is not desirable and shall only be used where specifically approved by Council.

1.15.9 Speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by 'segmenting' streets into relatively short lengths (less than 200-300m), using appropriate devices, streetscapes, or street alignment to create short sight lines.

1.15.10 Adequate critical sight distances should be provided such that either party in a potential conflict situation may take evasive action. Sight distances should relate to likely operating speeds.

1.15.11 Sight distances to be considered include those of and for pedestrians, cyclists and property accesses, as well as for drivers.

1.15.12 Night time visibility of street features and LATM devices must be adequate and in accordance with the MUTCD.

1.15.13 Many devices will be designed for their normal use by cars, but with provision (such as mountable kerbs) for larger vehicles. Some typical dimensions include:

1.15.13.1 Pavement narrowing:

1.15.13.1.1 Single lane 3.5m between kerbs;

1.15.13.1.2 Between obstructions - 3.75m; and

1.15.13.1.3 Two lane 6.0m minimum between kerbs.

1.15.13.2 Bicycle lanes (including adjacent to pavement narrowings) – 1.5m minimum;

1.15.13.3 Plateau or platform areas;

1.15.13.4 75mm to 150mm height maximum, with 1 in 15 ramp slope;

1.15.13.5 Dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates.

DG 1.16 Bus Stops

1.16.1 Bus stops should be provided on all bus routes so no more than 10 per cent of residents should have to walk in excess of 500 metres to catch a bus. Normally roads above the access street in the hierarchy are designed as bus routes. Table D1.2 details minimum criteria for bus stops.

1.16.2 Unless otherwise approved, bus stops shall be constructed in accordance with AUSTROADS Guide to Road Design, MUTCD and Disability Standards for Accessible Public Transport.

1.16.3 Tactile Ground Surface Indicators (TGSI) are to be installed at all bus stops and shelters in accordance with AS/NZS 1428.4:2009.

Table D1.2 Bus Stop Criteria

Road	Stops (Spacing)	Description
Collector Streets	400 metres [1]	Single Bay and shelter [2]
Trunk Collector or higher order road	400 metres	Single Bay and shelter [2]

Notes:

1. Loop roads with single entry/exits only require stops and bays on one side of the road.
2. Shelters are subject to Council's requirements.

DG 1.17 Access to Allotments

1.17.1 Criteria for acceptable access to allotments are to be in accordance with Council's Standard Drawings.

1.17.2 Criteria for acceptable access to steep allotments are to be in accordance with Section DG 2.12.

1.17.3 Criteria for acceptable access to lots in the Rural, Rural residential & Emerging communities zones are to be in accordance with Section DG 1.30.

1.17.4 All rear allotment access (hatchet or battleaxe lots), shall be provided with a reinforced concrete driveway (unless in a Rural, Rural residential or Emerging communities zone, where Council may approve another surface), have a minimum width of 3.0m and extend the full length of the access handle.

1.17.5 All rear allotment access driveways shall commence at the adjacent kerb and channel with a standard kerb crossover or at the existing edge of pavement. Conduits for internal allotment services are to be provided adjacent to the concrete driveway for the full length of the access unless otherwise approved.

1.17.6 All rear allotment access via an easement to more than one lot, shall be provided with a reinforced concrete driveway (unless in a Rural, Rural residential or Emerging communities zone, where Council may approve another surface) and have a minimum width of 5.5m to allow two-way access.

1.17.7 Where lots are accessed via an access easement, a 10.0m transition to singular (3.0m wide) access may be provided from the second last lot's crossover extending the full length of the access handle to the last lot.

1.17.8 All lots associated with an access easement must only gain access through the access easement.

DG 1.18 Parking Provisions

1.18.1 Parking provisions in accordance with the relevant sections of Austroads and/or Complete Streets shall be accorded with on all roads, except that for Major Collector Street with a traffic generation of 3000 vpd - 5999 vpd.

1.18.2 Streets which cannot comply with the on-street parking provisions of Austroads and/or Complete Streets, due to reduced allotment frontage widths or carriageway widths, shall make provision for indented or verge parking bays at a minimum frequency of 1 parking bay per 2 allotments. Particular attention should be made to providing adequate provision for on-street parking at cul-de-sacs, turning heads and elbow bends.

1.18.3 Verge widths are to be maintained alongside indented or verge parking areas. Where necessary, property boundaries shall be adjusted to meet this requirement.

DG 1.19 Pathways

1.19.1 Unless otherwise approved, pathways will be constructed taking into consideration the Disability Discrimination Act and Disability Standards for Accessible Public Transport.

1.19.2 Where a pathways link is located between allotments, the minimum width of land dedicated to Council shall be 5.0m. Concrete paving is to be for the full width of the pathway link and at least 2.5m wide and extend to the adjacent kerb and channel together with a kerb ramp. Vehicular access is to be restricted at the ends of pathways through the installation of bollards at the property line in accordance with the Councils requirements.

1.19.3 Maximum cross fall on all access pathways 2.5%.

1.19.4 Pathways constructed using alternate material (e.g. Asphalt, Paving blocks) are to be approved by Council.

1.19.5 The pathway shall extend to the property boundary remote from the roadway where the path is not connecting two street frontages.

1.19.6 Bends shall be provided with a minimum internal radius of 6m.

1.19.7 All pathways shall have a non-slip surface, generally, this can be achieved by applying a stiff broom to the wet surface. (Alternate methods shall require Council approval).

1.19.8 Where a pathway link is used for stormwater drainage overland flow relief it shall have a one way crossfall and be constructed in full width concrete with a

layback kerb and channel or approved equivalent along one edge to contain the required flow within the concrete.

1.19.9 Pathways are not to be aligned with stormwater pits where a stormwater pit is required to be located at the end of a pathway for overland flow, the pedestrian path is to be offset and appropriate measures provided to guide pedestrians away from the pit and remove any potential hazards.

1.19.10 The requirements for pathways to be constructed longitudinally along roads shall be in accordance with Table D1.3.

Table D1.3 Pathways along roads

Road Classification	Pathway Requirements [2]
Access Place	Nil (Kerb ramps to intersections only)[1]
Access Street	1.5m wide Pathway on one side of the reserve[3]
Collector Street	2.0m wide Pathway on one side of the reserve[3]
Sub Arterial/Arterial	2.5m wide Pathway on both sides of the reserve
Industrial	1.5m wide Pathway on each side of the reserve.

Notes:

1. **Unless required as part of a pedestrian/cycle network;**
2. **Minimum widths in the above table may be varied with the approval of Council;**
3. **Increase to 2.5m for cycleways.**

1.19.11 All pathways shall have appropriate immunity against cross drainage.

1.19.12 The maximum gradient shall be 16 per cent with a maximum crossfall of 2.5 per cent. Where the pathway is parallel with a road with a grade greater than 16 per cent footpath gradient shall match that of the road.

1.19.13 The finished surface level of concrete work shall be not more than 20mm above the finished surface level of adjoining ground and shall finish flush with adjoining hard surfaces.

DG 1.20 Bikeways

1.20.1 The minimum width of land dedicated to Council for a bikeway shall be 5.0 metres with a minimum 2.5 metre wide concrete paving in accordance with Cycling Aspects of AUSTROADS Guides and MUTCD - Part 9, Bicycle Facilities.

1.20.2 Bikeways constructed using alternate material (e.g. Asphalt, Paving blocks) are to be approved by Council.

1.20.3 Bikeways located in parks shall be constructed above the flow of a storm of 5 year ARI, unless approved otherwise by Council.

1.20.4 Where bikeways connect to or crosses over an Access Street or higher order road, a slow point shall be installed as approved by Council.

1.20.5 All bikeways shall have a non-slip surface. Generally, this can be achieved by applying a stiff broom to the wet surface. (Alternate methods require Council approval).

DG 1.21 Kerb and Channel

1.21.1 Concrete kerb and channel, and layback kerb and tray shall be provided on both sides of all roads except as otherwise provided for in Austroads and/or Complete Streets.

1.21.2 Standard kerbs in accordance with Council's Standard Drawing shall be used in the following cases:

- 1.21.2.1 Residential Streets – Layback Kerb and Layback Kerb and Channel;
- 1.21.2.2 Medians – Maintenance Strip Kerb;
- 1.21.2.3 Grassed and Landscaped Traffic Islands – Maintenance Strip Kerb;
- 1.21.2.4 Concrete Traffic Islands - Semi-mountable Kerb; and
- 1.21.2.5 Roundabouts (centre island only), - Maintenance Strip Kerb.

1.21.3 Where proposed construction adjoins existing kerb and channel the Designer shall confirm with Council whether the existing profile shall be extended or whether the new construction will be tapered smoothly to the existing kerb and channel. The grading of kerb and channel will normally conform to the road centreline grading. However, at locations where the kerb and channel grading diverts from the centreline grade, such as at intersections or on superelevated curves the following shall apply.

1.21.4 Minimum channel grade should be 0.5 percent unless approved other approved by Council.

1.21.5 Every effort should be made to provide vertical curves as long as possible, for improved appearance.

1.21.6 At all changes in horizontal alignment, kerbs and kerb and channel shall be constructed with horizontal curves.

1.21.7 To improve appearance where small deflections occur (e.g. on tapers), horizontal curves shall be as long as possible. Refer also to current Department of Main Roads or AUSTROADS.

1.21.8 Kerb ramps shall be provided at all tangent points of intersection kerb returns, at park entrances and at any other locations where required by Council.

1.21.9 Access crossovers for Industrial, Commercial and Multi Residential site shall be installed in accordance with Council's Standard Drawings.

DG 1.22 Signs and Road Markings

1.22.1 Permanent signing and road marking shall be in accordance with the current edition of the MUTCD. Where there is a choice of line marking colour, then only white or yellow paint is to be used.

1.22.2 Temporary or construction signing and road marking shall be in accordance with current edition of the MUTCD.

1.22.3 The relevant sign reference number from the MUTCD shall be included on the construction drawings.

1.22.4 All signs and pavement markings shall be adequately dimensioned to ensure accurate setting out.

1.22.5 Signs located in grassed areas shall have a surrounding 500mm dia x 100mm thick concrete mowing strip.

1.22.6 Signs located in concrete islands or medians shall be installed with the "V Loc" socket system and fitted with anti-theft bolts.

1.22.7 The bottom of all un-sleeved posts shall be flattened prior to placing in concrete footing.

1.22.8 Vandal proof bolts and fittings shall be used on all permanent signing.

1.22.9 Street Name signs shall be installed in accordance with Council's Standard Drawing.

DG 1.23 Road Edge Guide Posts & Guardrails

1.23.1 Road edge guide posts shall be provided at all locations where concrete kerb and channel is not constructed e.g. half road construction, tapers, ends of roads etc.

1.23.2 Guide posts shall conform to and be installed in accordance with Department of Main Roads 'Manual of Uniform Traffic Control Devices'.

1.23.3 Guardrails shall be installed in accordance with the Department of Main Roads Road Planning and Design Manual.

DG 1.24 Pedestrian Foot Bridges

1.24.1 Pedestrian foot bridges are to be provided where necessary and are to be constructed from concrete, steel or timber (all steelwork is to be hot dipped galvanised) and shall be provided with handrails / fences for pedestrian safety.

1.24.2 The clear width of all pedestrian bridges shall match the width of the approaching pathway / bikeway unless otherwise approved by Council and shall have squeeze points to control access.

1.24.3 Designers shall consult with Council at concept stage to confirm location, widths, flood immunity etc.

DG 1.25 Tram Line Crossings

1.25.1 Road crossings are to be constructed in accordance with Department of Transport and Main Roads Standard Drawings.

1.25.2 Flashing lights and crossing warning signs to the Department of Transport and Main Roads standards are to be erected on all new road crossings or crossings where the traffic density will increase because of the development.

1.25.3 Prior to commissioning of flashing lights and warning lights appropriate temporary controls including warning signage shall be installed and maintained at all road crossings.

DG 1.26 Fencing

1.26.1 All fencing located inside the road reserve shall have a minimum height of 1.2m, and shall be of a type that discourages climbing and constructed in accordance with Council's Standard Drawing.

1.26.2 A continuous chain wire mesh fence shall be constructed along all interfaces between the development and the tramway reserve and shall be constructed in accordance with Council's Standard Drawing.

Rural Design Criteria

DG 1.27 General

1.27.1 In addition to the foregoing sections this section specifically applies to all those sites identified as being suited to rural and rural residential subdivisions inclusive of rural home sites and hobby farms types of developments. For roads within the Rural Living Areas reference should be made to Table D1.1. Table D1.4 details specific road demands for rural roads.

	Rural Access Place	Rural Access St	Rural Collector	Rural Sub Arterial	Rural Arterial
Traffic Volumes or Road Class (vpd)	<100	100-199	200-999	1000-7999	>8000
Road Reserve (flat terrain ≤ 5%)	20m	20m	20m	25m	25m
Road Reserve[2] (undulating/Hilly >5%)	25m	25m	25m	30m	30m
Formation	8m	8m	10m	10m	12m
Pavement Width	6m	6m	6.5m	8m	10m
Seal Width	Optional[1]	6m (min)	6.5m	8m	10m
Shoulders[3]	1.0m	1.0m gravel	1.75m gravel	As collector Incl. 0.5m sealed on each side	As collector Incl. 1.5m sealed on each side
Desirable Speed Environment	80km/h	80km/h	100km/h	100km/h	100km/h
Design Speed for Individual Elements (Minimum)	80km/h	80km/h	80km/h	80km/h	80km/h

Notes:

1. **Sealing 4.0m wide shall be required for longitudinal grades in excess of 10% and may be required at sites where existing adjacent roads are sealed.**
2. **In undulating terrain, this width shall be increased to enable services to be constructed on accessible flatter land on top and below batters.**
3. **Where the road is a designed on-road bicycle route (signposted and pavement marked) the shoulder provision needs to confirm to AUSTROADS Part 14 – Bicycles.**

1.27.2 Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in AUSTROADS Guide to Road Design.

1.27.3 Where appropriate superelevation, widening and centreline shift and their associated transitions are to comply with AUSTROADS Guidelines.

1.27.4 Where the table drain will have a flow velocity greater than 2.5m/s or is likely to scour, a stone pitched, or suitably lined dish drain is to be constructed along the invert. (Generally, table drains steeper than 6 % will require scour protection).

DG 1.28 Horizontal and Vertical Alignment

1.28.1 Horizontal and vertical curves are to be designed generally to the requirements of AUSTROADS Guide to Road Design. These requirements are essential to satisfy the safety and performance of proper road design. Roads having both horizontal and vertical curvature should be designed to conform to the terrain to achieve desirable aesthetic quality and being in harmony with the landform.

DG 1.29 Intersections

1.29.1 Intersections should generally be in accordance with AUSTROADS.

1.29.2 Adequate sight distance should be provided at intersections both horizontally and vertically. Each intersection location shall be examined for conformance with the criteria for Approach Sight Distance (ASD), Entering Sight Distance (ESD) and Safe Intersection Sight Distance (SISD).

DG 1.30 Access to Allotments

1.30.1 All accesses onto sealed roads are to be sealed. Accesses off gravel roads do not have to be sealed.

1.30.2 Drainage under accesses shall be designed and constructed to a size and length as determined by RPEQ. Minimum pipe size – 375mm diameter, Minimum length – 4.8m long.

1.30.3 All pipe and box culverts under accesses shall have headwalls to protect and retain gravel fill.

1.30.4 Precast vertical headwalls with wings are preferred, but insitu cast concrete or grouted stone may be used subject to Council Approval.

1.30.5 Precast sloping headwalls to be used on all access where the road design speed is 100km/h or where the culvert is within 4.5m of the traffic lane and the road speed is 80 km/h.

1.30.6 Accesses are to be designed to ensure that stormwater runoff from the road and the access discharge to the table drain.

1.30.7 Accesses shall be constructed in accordance with Council's Standard Drawing unless otherwise approved by Council.

DG 2 – DESIGN GUIDELINES - Site Regrading

General

DG 2.1 Scope

2.1.1 This section sets out the minimum standard specifically designed for site regrading involved land development and subdivision.

2.1.2 The designer needs to make reference to the associated design manual related to DG 1 – Road Geometry, DG 4 – Stormwater Drainage and DG 5 – Stormwater Quality Management.

DG 2.2 Objectives

2.2.1 This Manual aims to assist the Designer in achieving:

2.2.1.1 Efficient and economical design;

2.2.1.2 Enhancement of the environmental character and maintenance of natural features of the site; and

2.2.1.3 Minimal impact on adjoining properties and developments.

DG 2.3 Reference Documents

2.3.1 AS3798 Guidelines on Earthworks for Commercial and Residential Development

2.3.2 AS4373 Pruning of Amenity Trees

2.3.3 AS4970 Protection of Trees on Development Sites

2.3.4 State Planning Policy

DG 2.4 Site Regrading Concept

2.4.1 Areas of a site proposed for building or recreational purposes may not be suitable in their natural state for their intended function without improvement works, the designer shall review the natural surface contours and where necessary shall design finished surface levels that ensure the land is suitably prepared.

2.4.2 Excessive site regrading should be avoided, wherever possible site layouts should be developed to position roads and drainage networks to take advantage of natural surface grades. Site layouts that minimise the disturbance of the land will require less erosion and sediment control measures during construction phase and reduce the risk of environmental harm.

2.4.3 The designer shall consider the implications of site regrading in relation to the existing natural environment. Generally, site regrading shall be minimised in heavily treed areas.

2.4.4 The design of site regrading areas preferably should aim to achieve a balanced cut to fill to minimising haulage of imported fill or spoil to and from the development site.

2.4.5 Where practical, areas should be regraded to minimise the necessity for underground drainage systems with surface inlet pits, and allow surface water to flow naturally to roads or drainage reserves without excessive concentration.

DG 2.5 Clearing

2.5.1 Unless otherwise approved by Council any pruning and/or protection of trees shall be carried out in accordance with AS 4970 and AS 4373.

2.5.2 Clearing must be kept to a minimum. Trees and vegetation of significance shall be identified prior to design in order that the amount of disturbance may be minimised through appropriate design.

2.5.3 Reference should be made to the Vegetation Management Act and any relevant Local Laws and Policies prior to any tree clearing.

2.5.4 Generally, in areas with significant trees and vegetation:

2.5.4.1 Roadways clearing shall be limited to the limits of approved earthworks plus a sufficient lateral clearance to ensure that the works are not interfered by the trees or vegetation; and

2.5.4.2 Allotment clearing shall be limited to the minimum areas required to safely construct services such as sewers and catchment drains, and the limits of approved earthworks to allotments plus a sufficient lateral clearance to ensure the works are not interfered by the trees or vegetation.

2.5.5 No trees shall be damaged or removed from areas to be dedicated under the control of Council without prior written approval of Council.

2.5.6 Trees on existing roads shall not be damaged or removed without the approval of Council. All trees on existing roads affected by the works shall be shown and details given of proposed protection or relocation methods.

2.5.7 Prior to any clearing, all existing and future parkland shall be delineated to ensure its protection from unauthorised clearing.

DG 2.6 General Standard of Lot Preparation

2.6.1 Special requirements will apply where necessary but generally lots are to be cleared of low scrub, fallen timber, debris, stumps, large rocks and any trees which in the opinion of Council are approaching the end of their functional life or are dangerous or will be hazardous to normal use of the development. Prior consultation with Council is necessary. Such requirements shall be shown on the design plan.

2.6.2 Class 1, 2 and 3 Pest Plants are to be removed and disposed of in accordance with Land, pest and Stock Route Management Act and Regulation.

2.6.3 All timber and other materials cleared from lots shall be removed from the site. All roots, loose timber, etc which may contribute to drain blockage shall be removed.

2.6.4 All trees nominated by Council in its conditions of approval shall be preserved by approved means to prevent destruction normally caused by placement of conventional filling or other action within the tree drip zone. Details of the proposed protection measures shall be detailed on the design plans.

DG 2.7 Filling

2.7.1 If any land is to be filled all practices must ensure compliance with AS 3798 ”Guidelines on Earthworks for Commercial and Residential Developments” and State Planning Policy 2/02.

2.7.2 Fill comprising industrial wastes or by-products is not permitted.

2.7.3 No person shall be permitted to fill any land where, in the opinion of Council, such filling will detrimentally affect the area available in any natural or artificial watercourse for either present or estimated future flood flows, or will detrimentally reduce the volume within a flood plain available for the storage of flood waters.

2.7.4 No person shall be permitted to fill any land if such filling may detrimentally affect natural drainage of any of the surrounding land.

2.7.5 All new allotments are to be flood free. Immunity levels shall be in accordance with relevant Council Policies and Planning Scheme requirements.

2.7.6 Every allotment shall be filled and drained to achieve Council's performance criteria, such that an area is available above the adopted flood line, or stipulated flood level, in accordance with the following documents:

2.7.6.1 Queensland Urban Drainage Manual (QUDM);

2.7.6.2 Council's Local Laws & Policies; and

2.7.6.3 Council's Flooding and Drainage Policies

DG 2.8 Compaction

2.8.1 Compaction of earthworks shall be in accordance with AS 3798 “Guidelines on Earthworks for Commercial and Residential Developments”.

DG 2.9 Cartage of Soil

2.9.1 The designer shall nominate in their design submission whether excess spoil is generated by the proposed earthworks and in these cases shall nominate the proposed spoil dump site and external haul route which shall be subject to the written approval of the Council.

2.9.2 In cases where the spoil is generated from works within existing declared roads, Council may nominate that the spoil be placed on Council controlled land within 5 km of the project site.

2.9.3 Where rock is disposed of on site, the position of the rock is to be approved by Council and shown on the ‘as constructed’ drawings.

2.9.4 Unless otherwise approved by Council all topsoil shall be retained on the development site and utilised effectively to encourage appropriate revegetation.

DG 2.10 Allotment Earthworks

2.10.1 Allotments shall be provided with a minimum finished surface gradient of 0.5%, including catch drains, to facilitate drainage.

DG 2.11 Batter Treatments

2.11.1 Cut and fill batters shall not straddle allotment boundaries unless otherwise approved by the Council.

2.11.2 Cut batters shall not extend into existing or proposed parks or bushland reserves unless specifically approved by Council. Fill batters may extend into proposed parks or bushland reserves with a maximum slope of 1 in 10 unless otherwise approved by Council.

2.11.3 In general, cut and fill batters shall be limited to a maximum slope of 1 in 4 (1 in 10 in parks), such that stabilisation is achieved by topsoiling and grassing which can be maintained by conventional tractor slasher.

2.11.4 All embankments and cuttings must be outside the road reserve. The toe of any cut batter is to be 300mm inside the property boundary; the top of any fill batter is to be 300mm inside the property boundary.

2.11.5 In environmentally sensitive areas or steep terrain, consideration may be given to relaxation of clause 4 subject to council approval.

2.11.6 Where subdivision roads are constructed in fill and the batter slope exceeds 1 in 2, Council may require an easement over the batter and to a nominated distance past the toe of the batter.

2.11.7 Batters in road reserves but outside the verge steeper than 1 in 4 may be retained by a retaining structure subject to approval by the Council.

2.11.8 On private land, batters should preferably be 1 in 4 or flatter for batters fronting the road reserve and 1 in 2 elsewhere. Batters steeper than 1 in 2 may be approved subject to the submission of an acceptable landscape treatment.

2.11.9 All batters steeper than 1 in 2 and higher than 1.5m shall require certification as to stability by a Registered Professional Geotechnical Engineer (RPEQ).

DG 2.12 Allotment Accesses

2.12.1 The slope of the natural surface can result in difficulty in providing vehicular access to allotments fronting the road. Driveway grades within the property should be limited for safety and amenity. Refer Table 2.1 for Maximum Driveway Grades

Table D2.1 Maximum Driveway Grades

Location	Desirable	Maximum
Residential	16.6% (1 in 6)	20% (1 in 5) for 6m in every 12m
Industrial	10% (1 in 10)	16.6% (1 in 6)
Maximum change in driveway grades – all areas[1]	8%	10%

Notes:

1. Change of grade is expressed algebraically as the change in gradient between the two roadway grades.

2.12.2 Steep allotment access (10% or greater) and drainage shall be designed and constructed to include the following (unless otherwise approved by Council):

2.12.2.1 The driveway must be a minimum of three (3) metre wide concrete slab, with barrier kerb and channel provided on one side for vehicular safety and drainage purposes;

2.12.2.2 The driveway shall be constructed in such a manner as to ensure that the crossfall of the driveway be one-way and directed into the hill, for vehicle safety and drainage purposes;

2.12.2.3 A turn around shall be provided adjacent to each of the proposed dwellings sufficient to allow turning movements for an emergency services vehicle;

2.12.2.4 The driveway shall be located to minimise the visual impact, and minimise the amount of earthworks required; and

2.12.2.5 Both sides of the areas adjacent to the driveway shall be re-vegetated to minimise visual impact. This information is to be included in the application for engineering approval.

DG 2.13 Retaining Walls

2.13.1 All retaining walls are to be 150mm from the property boundary or back for the footing to be wholly contained within the allotments that the retaining wall sits.

2.13.2 Council will allow retaining walls to be constructed up to a maximum height of 1.0m without structural certification provided they are constructed fully in accordance with the technical literature provided by the manufacturer (i.e. Koppers logs, Keystone or similar).

2.13.3 All retaining walls greater than 1.0m high must be designed, detailed and certified by a structural RPEQ. Structural certification and geotechnical assessment if required shall be submitted to Council with design submission.

2.13.4 Retaining walls shall be designed to consider the location of any adjacent services (e.g. sewer). The minimum horizontal clearance between any adjacent services and the outermost edge of the retaining wall structure shall 800mm and outside the zone of influence whichever is the greater. Retaining walls must be designed to ensure that no imposed loads are applied directly to service infrastructure. Retaining walls adjacent to services shall be subject to Council approval.

2.13.5 Retaining walls associated with residential allotments or stormwater drainage must have a design life of 60 years.

2.13.6 All retaining walls must comply with the requirements of AS 4678 – Earth retaining structures.

DG 2.14 Earthworks on Hillslopes

2.14.1 Where earthworks are proposed in any development where the slope of the land exceeds 15% (unless otherwise agreed), Council requires a report from a qualified Geotechnical RPEQ addressing slope stability and construction issues.

2.14.2 The designer shall incorporate the specific measures and recommendation contained within the geotechnical report to control soil and rock movements into the design of roads and house bench pads.

2.14.3 Where batters are 2.0 meters or higher a risk assessment is to be undertaken by the Engineer to determine if fencing is required to be undertaken in accordance with the relevant Australian Standard.

DG 2.15 Earthworks to Parks

2.15.1 All earthworks within proposed or existing parkland shall:
- 2.15.1.1 Be adequately drained;
- 2.15.1.2 Have no batters exceeding 1 in 10; and
- 2.15.1.3 Have acceptable landscaping in accordance with Council's minimum standards.

DG 2.16 Footpaths/Verge Crossfall

2.16.1 All footpaths / verges shall fall from the frontage property boundary to the adjacent kerb and Whitsunday Regional Council Planning Scheme 2017– Schedule 6 –June 2017 (V3.5) 77 channel with acceptable crossfalls of between 2.5% - 5%. In the case where the allotment falls away from the road reserve (i.e. the allotment is lower than the level of the road), the footpath / verge shall have a minimum fall from the frontage property boundary to the adjacent kerb of 3%.

DG 2.17 Topsoiling and Grassing

2.17.1 Topsoil is defined as surface soils high in organic matter and contaminated by residual grass seeds and grass roots.

2.17.2 The area under paved areas, footpaths, batters and areas of fill shall be stripped of topsoil and any other organic matter.

2.17.3 On the completion of the works, topsoil shall be re-spread to allotments, batters and footpaths and fill areas to a depth of 75mm with an absolute minimum of 40mm.

2.17.4 The footpath areas, batters and all disturbed areas including allotments are to be trimmed and drill seeded with an approved grass species.

2.17.5 All cut and fill batters shall be hydro-mulched or approved equivalent.

DG 2.18 Inspection Requirements

2.18.1 Inspections and testing requirements for all allotments and roads shall be to Level 1 in accordance with AS 3798 “Guidelines on Earthworks for Commercial and Residential Developments”.

2.18.2 A higher level of inspection and testing may be required for more significant works as determined by Council.

2.18.3 Council may approve a lower level of inspection and testing for minor works and drainage works.

DG 3 - DESIGN GUIDELINES – Road Pavements

General

DG 3.1 Scope

3.1.1 This section sets out the minimum standards for the design of the road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface.

3.1.2 The Manual contains procedures for the design of the following forms of road pavement construction:

- 3.1.2.1 Flexible pavements; and
- 3.1.2.2 Rigid pavements (i.e. concrete pavements).

3.1.3 Generally flexible pavements designed in accordance with this manual are preferred for road pavement construction in North Queensland. Council may examine pavement designs for rigid pavements subject to detailed engineering submissions of any such proposals. Council reserves the right to refuse any alternate proposal for pavement design.

DG 3.2 Objectives

3.2.1 The objective in the design of the road pavement is to select appropriate pavement and surfacing materials, types, layer thicknesses and configurations to ensure that the pavement performs adequately and requires minimal maintenance under the anticipated traffic loading for the design life adopted.

DG 3.3 Reference Documents

3.3.1 Department of Transport and Main Roads

- 3.3.1.1 Pavement Design Supplement
- 3.3.1.2 MRTS 30Asphalt Pavements
- 3.3.1.3 Road Planning and Design Manual Chapter 3 Appendix A 1st Edition

3.3.2 AUSTROADS / ARRB Publications

- 3.3.2.1 Guide to Pavement Technology
- 3.3.2.2 Guide to Road Design
- 3.3.2.3 Design of Sprayed Seals
- 3.3.2.4 ARRB-SR35 - Special Report No. 35 - Subsurface Drainage of Road Structures
- 3.3.2.5 APRG 21 - Report No. 21 - A guide to the design of new pavements for light traffic

3.3.2.6 Special Report No. 35 Subsurface Drainage of Road Structures
3.3.2.7 Guide to Pavement Structural Design
3.3.2.8 Technical Report – Pavement Design for Light Traffic – A supplement to Austroads Pavement Design Guide AP-T36/06

3.3.3 Cement and Concrete Association of Australia.
3.3.3.1 T51 Concrete Pavement Design for Residential Streets and Paths

3.3.4 Concrete Masonry Association of Australia.
3.3.4.1 T44 Concrete Segmental Pavements - Guide to Specifying
3.3.4.2 T45 Concrete Segmental Pavements - Design Guide for Residential Access Ways and Roads
3.3.4.3 T46 Concrete Segmental Pavements - Detailing Guide

Pavement Design Criteria

DG 3.4 Design Variables

3.4.1 Regardless of the type of road pavement proposed, the design of the pavement shall involve consideration of the following five input variables:
3.4.1.1 Design Traffic;
3.4.1.2 Subgrade Evaluation;
3.4.1.3 Environment Factors;
3.4.1.4 Pavement and Surfacing Materials; and
3.4.1.5 Construction and Maintenance Considerations

DG 3.5 Design Traffic

3.5.1 The design traffic shall be calculated based on the following minimum design lives of pavement:
3.5.1.1 Flexible - 20 years;
3.5.1.2 Rigid (Concrete) - 40 years; and
3.5.1.3 Segmental Block - 25 years.

3.5.2 Unless determined otherwise by the Council, the minimum number of design Equivalent Standard Axles (ESA's ie, 80 kN axle load passes) for the various road categories shall be as calculated in accordance with the requirements of the AUSTRODS publications Guide to Pavement Technology and APRG Report 21 - A guide to the design of new pavements for light traffic. For design traffic volumes approaching or exceeding 5 x 10^5 ESA's (Trunk Collector Street), Department of Transport and Main Roads' Pavement Design Manual shall be used.

3.5.3 Design traffic shall be calculated for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity. For new subdivisions, the design traffic shall take account of both the construction

traffic associated with the subdivision development, the in-service traffic, proposed and potential public transport routes and connection to adjacent development.

3.5.4 For interlocking concrete segmental pavements, the simplification of replacing ESA's with the number of commercial vehicles exceeding 3 tonne gross contained in CMAA – T45 is acceptable up to a design traffic of 5 x 5^5.

3.5.5 The pavement design shall include all traffic data and/or assumptions made in the calculation of the design traffic.

3.5.6 In the absence of other traffic data, the traffic values provided in Table D3.1 may be taken as a Whitsunday Regional Council Planning Scheme 2017– Schedule 6 –June 2017 (V3.5) 82 guide to the minimum design traffic, but shall be subject to variation depending on the circumstances for the particular development.

Table D3.1 Minimum Traffic Loadings

Street Type	%CV[1]	%ESA/CV	Minimum ESA's
Urban			
Access Place	3.6	1.0	$5x10^4$
Access Street	5	1.0	$1x10^5$
Minor Collector Street	7	1.0	$5x10^5$
Major Collector Street	10	1.0	$1x10^6$
Sub Arterial	10	1.0	$3.25x10^6$
Rural			
<250vpd	5	1.0	$2.5x10^5$
>250vpd	9	1.0	$2.5x10^6$
Industrial	To be determined by specific design data		$5x10^5$
Business/Commercial	To be determined by specific design data		$5x10^5$

Notes:

1. Consider potential for bus routes.

DG 3.6 Subgrade Evaluation

3.6.1 Subgrade evaluation shall be carried out by a NATA registered materials test authority on each different natural sub-grade material evident and shall be by the conduct of soaked 4 day CBR laboratory testing.

3.6.2 Design CBR for each subgrade area shall be determined in accordance with the method outlined in AUSTROADS publications Guide to Pavement Technology and ARRG Report 21 - A guide to the design of new pavements for light traffic.

3.6.3 The following factors must be considered in determining the design strength/stiffness of the subgrade:

3.6.3.1 Sequence of earthworks construction;

3.6.3.2 The compaction moisture content and field density specified for construction;
3.6.3.3 Moisture changes during service life;
3.6.3.4 Subgrade variability; and
3.6.3.5 The presence or otherwise of weak layers below the design subgrade level.

3.6.4 The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure.

3.6.5 If the in situ subgrade test results in a CBR of 3 or less, the pavement is to be designed with input from RPEQ engineer experienced in the design of road pavements.

DG 3.7 Environment Factors

3.7.1 The environmental factors, which significantly affect pavement performance, are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to AUSTROADS publications Guide to road Design and Special Report No. 35 Subsurface Drainage of Road Structures.

3.7.2 The following factors relating to moisture environment must be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:
3.7.2.1 Rainfall/evaporation pattern;
3.7.2.2 Permeability of wearing surface;
3.7.2.3 Depth of water table;
3.7.2.4 Relative permeability of pavement layers;
3.7.2.5 Whether shoulders are sealed or not;
3.7.2.6 Pavement type (boxed or full width); and
3.7.2.7 Subject to flooding (e.g. Causeways and Floodways).

3.7.3 The effect of changes in moisture content on the strength/stiffness of the subgrade shall be taken into account by evaluating the design subgrade strength parameters (i.e. CBR or modulus) at the highest moisture content likely to occur during the design life, i.e. the Design Moisture Content. The provision of subsurface drainage may, under certain circumstances, allow a lower Design Moisture Content, and hence generally higher Design CBR.

3.7.4 The pavement design shall include all considerations for environmental factors, and any assumptions made that would reduce or increase design subgrade strength or affect the choice of pavement and surfacing materials.

DG 3.8 Materials Testing

3.8.1 All materials testing shall be carried out by a NATA registered materials testing authority using the procedures described in the manuals or codes of practice as appropriate to Department of Transport and Main Roads and Standards Association of Australia.

Pavement Thickness Design

DG 3.9 Pavement Structure – General

3.9.1 The minimum pavement provided shall be as detailed in Table D3.2

Table D3.2 Minimum Pavement Design Criteria

Street Type	Minimum Pavement (mm)[1]	Surface Treatment	Minimum Base Course CBR	Minimum Subbase Course CBR
Access Place / Access Street / Residential Street	200	Minimum 30mm AC	80	45
Collector Streets - **Minor** - **Major**	 250 250	 Minimum 30mm AC Minimum 30mm AC	 80 80	 45 60
Sub Arterial	300	50mm AC	80	60
Rural & Rural Residential **<100vpd** **100-999vpd** **>1000vpd**	 150 200 200	Gravel Two Coat Seal Two Coat Seal	 60 80 80	 45 45 60
Industrial	250	50mm AC	80	60

Notes:

1. **Minimum pavement thickness does not include the depth of surfacing.**
2. **All cul-de-sac heads and intersection turnouts in Rural and Rural Residential developments are required to have a 30mm asphalt surface treatment or concrete as a minimum.**

3.9.2 Notwithstanding subgrade testing and subsequent pavement thickness design, the thickness of subbase and base layers shall not be less than the following:

3.9.2.1 Flexible payment: Subbase 100mm, Base 100mm

3.9.2.2 Rigid pavement: Subbase 100mm, Base 150mm

3.9.3 The subbase layer shall extend a minimum of 150mm behind the rear face of any kerbing.

3.9.4 The base and surfacing shall extend to the face of any kerbing. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer shall also extend a minimum of 150mm behind the rear face of the kerbing. Regardless of pavement design, all kerbing to be constructed on a minimum of 100mm pavement material.

3.9.5 For un-kerbed roads, the subbase and base layers shall extend at least to the nominated width of shoulder.

3.9.6 A change of pavement types may be considered for intersection thresholds and traffic control features.

DG 3.10 Flexible Pavements

3.10.1 Flexible pavements with a design traffic up to 5 x 10^5 ESA's shall be designed in accordance with AUSTROADS publications Guide to Pavement Technology and ARRG Report 21 - A guide to the design of new pavements for light traffic.

3.10.2 Flexible pavement with a design traffic above 5 x 10^5 ESA's shall be designed in accordance with Department of Transport and Main Roads' Pavement Design Manual.

3.10.3 In areas of high water table (within 300mm of subgrade level). Base course should be cement modified (1% by weight)

3.10.4 Concrete segmental pavements with design traffic up to 5 x 10^5 and estimated commercial vehicles exceeding 3T gross shall be designed in accordance with CMAA-T45.

3.10.5 For design traffic above 5 x 10^5 estimated commercial vehicles exceeding 3T gross the design shall be in accordance with AUSTROADS Guide to Pavement Technology with the calculation of design traffic in terms of ESA's.

DG 3.11 Rigid Pavements

3.11.1 Rigid (concrete) pavements, with design traffic up to 5 x 10^5 ESA's shall be designed in accordance with either CCAA -T51 or AUSTROADS Guide to Pavement Technology.

3.11.2 Rigid (concrete) pavements for design traffic above 5 x 10^5 ESA's, the design shall be in accordance with AUSTROADS Guide to Pavement Technology.

Surfacing Design

DG 3.12 Bitumen Wearing Surface

3.12.1 Except where the pavement is designed for asphaltic concrete or segmental paver surfacing or where a gravel pavement is permitted, the wearing surface shall be a bituminous as follows:

3.12.1.1 Urban Residential, Low Density Residential – Primer or primer seal, plus 2 seal coats of sprayed bitumen) Seal (14mm / 7mm Aggregate) (only permitted where widening existing bituminous seals)

3.12.1.2 Rural & Rural Residential - Primer or primer seal, plus 2 seal coats of sprayed bitumen Seal (16mm / 10mm Aggregate).

DG 3.13 Segmental Pavers

3.13.1 Segmental pavers shall be concrete segmental pavers 80mm thick, shape Type A, and designed to be paved in a herringbone pattern unless otherwise approved by Council. Concrete segmental pavements are only to be used for pathways and local pavement 'highlight' features (e.g. 'threshold' treatments). The use of clay pavers on road wearing surfaces is not permitted.

3.13.2 The edges of all paving shall be constrained by either kerbing and/or guttering, or by concrete edge strips.

3.13.3 Sand bedding layers are to be provided with adequate drainage.

DG 3.14 Asphaltic Concrete

3.14.1 All roadworks shall be surfaced with an appropriate thickness of Asphaltic Concrete in accordance with Table D3.2.

3.14.2 Council requires the use of dense graded asphalt on all roads.

3.14.3 All roads greater than 10% in grade shall have a 10mm primer seal or other Council approved measure applied to the base course prior to the placement of the AC.

3.14.4 Asphalt Surfacing:

3.14.4.1 Where asphalt surfacing is required to be between 30mm and 50mm, it is considered to function as a wearing surface only;

3.14.4.2 Asphalt 40mm or thicker is required to be a dense graded asphalt (DG14) in accordance with Department of Transport and Main Roads' MRTS 30;

3.14.4.3 Asphalt of 30 – 40 mm thickness must be a dense graded asphalt (AC10) in accordance with Austroads; and

3.14.4.4 A light prime is to be applied over the pavement material prior to the asphalt being laid.

DG 3.15 Subsoil Drains

3.15.1 Subsoil or sub-pavement drains shall be provided on both sides of the formation in the following Whitsunday Regional Council Planning Scheme 2017– Schedule 6 –June 2017 (V3.5) 89 locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to allow for likely variations in subgrade and pavement moisture contents:

- 3.15.1.1 Cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level;
- 3.15.1.2 Locations of known hillside seepage, high water table or isolated springs;
- 3.15.1.3 Irrigated, flood-prone or other poorly drained areas;
- 3.15.1.4 Subgrades, which are highly susceptible to moisture, (i.e. commonly displaying high plasticity or low soaked CBRs);
- 3.15.1.5 Pavement materials, which are susceptible to moisture;
- 3.15.1.6 Existing pavements displaying signs of distress due to excess subsurface moisture; and
- 3.15.1.7 At cut to fill transitions.

3.15.2 Subsoil drains shall always be installed to all grassed/landscaped central medians and islands, unless otherwise approved by Council.

3.15.3 Where only one side of the formation is in cut, and the other side in fill, it may be sufficient to provide subsoil or sub-pavement drains only along the edge of the formation in cut.

3.15.4 In some circumstances it may be necessary to note on the engineering design the need for additional subsoil and sub-pavement drains that may become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation.

3.15.5 The requirements for subsoil drains should be assessed and designed by a registered geotechnical engineer or specialist pavement engineer.

3.15.6 Subsoil drains shall be constructed in accordance with Council's Standard Drawing.

3.15.7 In kerbed roads, the preferred location for the line of the trench is directly behind the kerb.

3.15.8 In un-kerbed roads, subsoil and sub-pavement drains shall be located within the shoulder, preferably at the edge of the pavement layers.

3.15.9 At the time of sub-soil drainage installation tree root barriers are to be installed in the appropriate locations and the kerb suitably marked (temporarily) to indicate where the tree is to be planted.

3.15.10 The minimum desirable longitudinal design grade shall be 1.0 - 1.5%. (Absolute minimum grade of 0.5%).

3.15.11 Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 300mm in earth and 200mm in rock. All subsoil drain trenches shall be wrapped in an appropriate geotextile fabric.

3.15.12 Outlets shall be spaced at maximum intervals of 150 metres. Where possible, subsoil and subpavement drainage pipes shall discharge into gully pits or other stormwater drainage structures. Where not possible, outlets shall be provided through fill batters.

3.15.13 Flushing Points are to be provided at the commencement of each run of drain, and at intervals not exceeding 50 metres. Flushing points shall generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.

3.15.14 Flushing Points and Outlets shall be constructed in accordance with Council's Standard Drawing.

DG 3.16 Drainage Mat (Blankets)

3.16.1 Drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to intercept and control seepage water and springs in the floors of cuttings, to intercept water which would otherwise enter pavements by capillary action or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

3.16.2 In embankments drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

3.16.3 In excavations drainage mats are constructed after completion of the subgrade construction and before construction of the pavement.

3.16.4 The minimum thickness of compacted filter material shall be 300mm plus an allowance for the expected consolidation or 500mm if the amount of consolidation of embankment foundation is not known.

3.16.5 The requirements for and design of drainage mats shall be undertaken by a geotechnical engineer experienced in the design of road pavements.

3.16.6 All drainage mats shall be wrapped in appropriate geotextile.

DG 4 – DESIGN GUIDELINES – Stormwater Drainage

General

DG 4.1 Scope

4.1.1 This section sets out the minimum standards for the design of stormwater drainage systems for urban and rural areas.

4.1.2 The designer needs to make reference to the associated design manuals related to D1 Road Geometry and D5 Stormwater Quality Management.

4.1.3 The Queensland Urban Drainage Manual (QUDM) shall be the basis for the design of stormwater drainage, except as amended by these manuals.

DG 4.2 Objectives

4.2.1 The objectives of stormwater drainage design are as follows:

4.2.1.1 To collect and convey stormwater from a catchment to its receiving waters with minimal nuisance, danger or damage and at a development and environmental cost which is acceptable to the community as a whole;

4.2.1.2 Limit flooding of public and private property, both within the catchment and downstream, to acceptable levels; and

4.2.1.3 To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed velocity/depth limits.

4.2.2 For new developments a stormwater drainage system in accordance with the "major/minor" system concept in accordance with QUDM; that is, the "major" system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events.

4.2.3 For redevelopment areas where the proposed development replaces an existing development, the on-site drainage system is to be designed in such a way that the estimated peak flow rate from the site for the design average recurrence interval (ARI) of the receiving minor system is no greater than that which would be expected from the existing development and is not concentrated in such a way as to cause nuisance to downstream properties.

DG 4.3 Reference Documents

4.3.1 Department of Energy and Water Supply - Queensland Urban Drainage Manual Institute of Engineers Australia.

4.3.2 Australian Rainfall and Runoff - A Guide to Flood Estimation Australian Standards

4.3.3 AS 3600-2009 Concrete Structures.

DG 4.4 General

4.4.1 The QUDM shall be the basis for design of stormwater drainage except where amended by these manuals.

4.4.2 Minor system flows (as defined by QUDM) are to be conveyed underground to a legal point of discharge unless otherwise approved by Council.

4.4.3 Councils have or are in the process of producing drainage management plans for particular catchments within their boundaries.

4.4.4 The design of the stormwater drainage system, for the development shall be such that the upstream drainage is not adversely affected and that the downstream drainage system is capable of adequately catering for the discharge of the modified flow produced as a result of the development.

4.4.5 If the downstream system is not capable of carrying the modified discharge, the designer shall indicate the measures proposed to ensure the downstream system is capable of carrying the modified discharge. This will involve negotiation with adjoining landowners for minor creek systems to produce easements over downstream drainage paths. Written approval from the respective property owners is required for the easement and any engineering works on their property from the development site to the legal point of discharge.

4.4.6 Alternatively, where a development will result in increased runoff the stormwater drainage system may include on-site measures to such as detention basins, to ensure that the peak discharge from the development area is restricted to a level no greater than that discharging prior to the development.

4.4.7 All works proposed within creeks and natural watercourse, or lands under the control of other Authorities must have the approval of all relevant authority prior to commencing the work and evidence of such approvals shall be provided with the design submission.

4.4.8 The design of the stormwater drainage system shall accommodate the future developed peak flows from upstream catchments on the basis of development in accordance with the Planning Scheme.

4.4.9 The designer shall be responsible for assessing the existing and future developed flow regime entering the development site from upstream catchments and shall provide detailed calculations with the design submission.

4.4.10 Unless approved otherwise by the Council, piped drainage systems shall extend to the boundaries of the subject land, with inlet and discharge works within the subject property.

4.4.11 All Material and components of the Stormwater Drainage system shall be durable and fit for purpose, with a minimum lifespan 60 years.

DG 4.5 Design Average Recurrence Interval

4.5.1 Design Average Recurrence Interval (ARI) shall be in accordance with Table D4.1 (modified from QUDM Table 7.3.1).

4.5.2 For the purpose of drainage, a major road shall be defined as a major collector or higher order road.

Table D4.1 Recommended Design Average Recurrence Intervals

Design Type	ARI Interval (years)	
Major System Design	100	
Minor System Design		
Central Business & Commercial	10	
Industrial	5	
Urban Residential High Density (greater than 20 dwelling units/ha)	10	
Urban Residential Low Density (greater than 5 and up to 20 dwelling units/ha)	5	
Rural Residential (2 to 5 dwelling units/ha)	5	
Open Space (Parks etc)	1	
Major Road	Kerb & Channel Flow	10[1]
	Cross Drainage (Culverts)	50[2]
Minor Road	Kerb & Channel Flow	Refer to relevant category in QUDM
	Cross Drainage (Culverts)	10[2]

1. The design ARI for the minor drainage system in a major road shall be that indicated for the major road, not that for the Development Category of the adjacent area; and

2. Culverts under roads should be designed to accept the full flow for the minor system ARI shown, in addition, the designer must ensure adequate public safety controls (e.g. D*V product) exist and that nominated Major Storm flow does not cause unacceptable damage to adjacent properties, or adversely affect the use of the land. If upstream properties are at a relatively low elevation, it may be necessary to install culverts of capacity greater than that for the minor system ARI design storm to ensure unacceptable flooding of upstream properties does not occur. In addition, the downstream face of causeway embankments may need protection where overtopping is likely to occur.

DG 4.6 Design Rainfall Data

4.6.1 Design Intensity Frequency Duration (IFD) Rainfall Charts can be obtained from http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016. The IFD Chart for the nearest suburb should be used for stormwater drainage design.

DG 4.7 Catchment Area

4.7.1 The catchment area of any point is defined by the limits from where surface runoff will make its way, either by natural or man-made paths, to this point. Consideration shall be given to likely changes to individual catchment areas due to the full development of the catchment.

4.7.2 The catchment boundary shall be determined by using the most accurate information available and details of catchments shall be provided to Council with the design submission.

DG 4.8 Kerb Inlets and Manholes

4.8.1 Kerb Inlet pits shall be in accordance with Council's Standard Drawings. All pits are to be recessed sufficiently to maintain a continuous lip line in accordance with these drawings. Alternate proprietary kerb inlets systems may be used only where approved by Council.

4.8.2 Where alternate proprietary kerb inlets systems have been approved for use by a Council, a copy of certified inlet capacity design charts for the alternate inlets shall be provided to Council with the design submission.

4.8.3 Blockage factors shall be used for the design of the drainage system as shown in Table D4.3.

Table D4.3 Kerb Inlet Blockage Factors

Inlet Type	Blockage Factor
On Grade – Side Entry (no grate)	20%
On Grade – Side Entry (with grate)	10%
On Grade – Grate Only	50%
Sag - Side Entry (no grate)	20%
Sag – Side Entry (with grate)	Nil
Sag – Grate Only	50%

4.8.4 The kerb inlet capacity design charts shall be used in accordance with the following:

4.8.4.1 Curves indicated on the charts that are shown in full are considered "Reliable" curves;

4.8.4.2 Curves indicated on the charts that are shown dashed up to an Approach Flow of 250 l/sec are considered "Satisfactory" for use;

4.8.4.3 Curves indicated on the charts that are shown dashed with an Approach Flow in the range 250 l/sec to 500 l/sec are "Estimates Only" and are to be used with caution in critical locations; and

4.8.4.4 No extrapolation beyond the limits of these charts shall be permitted.

4.8.5 Side entry pits with grates are preferred. Grated inlet pits with no side entry shall only be used in areas with a low risk of consequential damage from blockage and shall be subject to Council approval.

4.8.6 Manholes shall be provided on stormwater drainage lines in accordance with the requirements of QUDM. Manholes for pipes up to 1200mm dia shall be constructed in accordance with the Council's Standard Drawings. Council may examine proposals for the use of proprietary manufactured directional changes for stormwater systems and the acceptance of these will be subject to the satisfaction of the Council.

4.8.7 Other factors to be considered in the design are as follows:

- 4.8.7.1 Pits to be free draining;
- 4.8.7.2 Kerb inlet pits at intersections generally are to be located at the tangent point taking into account the position of pedestrian paths and kerb ramps. Inlets shall not be placed on kerb return unless specifically approved by Council;
- 4.8.7.3 Reductions in pipe sizes shall not be permitted; and
- 4.8.7.4 Pipework openings are to be located within a single wall. i.e. pipes shall not be permitted to enter through the corner of the pit structure.

4.8.8 The desirable maximum inlet pit depth should be limited to 1.5m to enable maintenance.

4.8.9 The desirable minimum and maximum stormwater manhole depth is to be limited to 1.2m and 3.0m respectively.

4.8.10 Inlet pits should be located at the mid-point of allotment frontages to reduce the likelihood of conflict with service conduits and future driveways.

DG 4.9 Pipes/Box Culverts

4.9.1 Stormwater drainage pipes and boxes shall be generally of reinforced concrete (including FRC) construction and in accordance with the following:

- 4.9.1.1 Minimum pipe size 375mm dia, minimum box culvert size 450mm x 300mm;
- 4.9.1.2 Minimum clear cover shall be 600mm in general or in accordance with manufacturers specification, otherwise approved by the Council;
- 4.9.1.3 The minimum vertical and horizontal clearances between a stormwater pipe and any other pipe or service conduit shall be 150mm;
- 4.9.1.4 In areas of high water table, the designer must consider buoyancy uplift in relation to pipe/culvert joints; and
- 4.9.1.5 In aggressive environments or where any part of the pipe / box culvert is below the Highest Astronomical Tide (refer to Queensland Tide Table for local conditions), pipes / box culverts will have cover to reinforcement in accordance with the exposure classification requirements of AS 3600.

DG 4.10 Overland Flow

4.10.1 Overland flow paths or emergency relief paths shall be formed and located in accordance with the requirements of QUDM. The following additional requirements shall also be required.

4.10.1.1 Where a pathway link is used for overland flow the pathway shall be concrete for its full width, shall have a maximum crossfall of 2.5 % and be constructed with a layback kerb and channel or approved equivalent along one edge. The ARI 100 year flow shall be contained completely within the pathway;

4.10.1.2 The footpath profile at the overland flow tip out point shall be designed to provide a fall from the kerb at the road edge towards the pathway / park;

4.10.1.3 Flows through parks shall have non-erosive velocity or adequate protection against scouring to the satisfaction of Council;

4.10.1.4 Where a stormwater pit is required to be aligned with a pathway for overland flow, the pedestrian path is to be offset and appropriate measures provided to guide pedestrians away from the pit and remove any potential hazards; and

4.10.1.5 Where flows discharge into receiving waters or drainage reserves, adequate protection against scouring of the batter slope shall be provided to the satisfaction of Council.

DG 4.11 Drainage Calculations

4.11.1 If a legal point of discharge and tailwater conditions have not been provided by Council as development conditions, they shall be confirmed with Council prior to proceeding with detailed design.

4.11.2 Hydraulic calculations shall generally be carried out in accordance with QUDM. The calculations shall substantiate the hydraulic grade line adopted for design of the system. A sample of a summary sheet for hydraulic calculations is given in QUDM.

4.11.3 Catchment plans and hydraulic calculations including any additional calculations in support of overland flow path capacities, weir flows over kerbs, culvert designs etc. shall be provided to Council with the design submission. Where a hydraulic modelling programme is used, calculations to be provided with the design including listings of all programme input parameters.

DG 4.12 Open Channels

4.12.1 Generally, open channels will only be permitted where they form part of the trunk drainage system and shall be designed to have smooth transitions with adequate access provisions for maintenance and cleaning. Where Council

permits the use of an open channel to convey flows from a development site to the receiving water, such a channel shall be designed in accordance with QUDM.

4.12.2 Maximum side slopes on grass lined open channels shall be 1 in 4, with a preference given to 1 in 6 side slopes, channel inverts shall generally have minimum cross slopes of 1 in 10.

4.12.3 Low flow provisions in open channels to prevent scouring from trickle flows shall be provided to all grass lined channels. Trickle flow protection shall be contained within a pipe or hard lined channel and shall be designed to cater for the 3 month ARI storm event (60 per cent of the 1 Year ARI storm event flow).

4.12.4 Subsurface drainage shall be provided in grass-lined channels to prevent waterlogging of the channel bed.

4.12.5 Profiles of all grass lined channels shall such that mowing may be undertaken by a tractor and slasher to the satisfaction of Council.

4.12.6 Where the flow velocity and / or depth within an open channel pose a safety hazard, barrier fencing and / or appropriate hazard warning signs shall be provided to discourage access to the channel. The extent of precautions should be determined following consultation with Council.

4.12.7 The depth velocity product and the gutter flow widths are to be included in the submitted drainage calculations.

DG 4.13 Allotment Drainage

4.13.1 Interallotment drainage systems must be designed in accordance with *Q.U.D.M section 7.13*. The minimum standard shall be Level 3 as defined in *Q.U.D.M table 7.13.4*, however the Engineer may direct a higher level for specific developments or parts thereof.

4.13.2 Interallotment drainage system must be provided to all allotments where:

- 4.13.2.1 Any part of the allotment falls away from the frontage roadway; or the mid-block finished surface level is less than 600 mm above the lowest invert level along the frontage kerb and channel.

4.13.3 Interallotment pipes shall generally be:

- 4.13.3.1 R.C. Pipe (minimum class 2) rubber ring jointed;
- 4.13.3.2 F.R.C pipe rubber ring jointed; and
- 4.13.3.3 uPVC pipes to be rubber ring jointed. Standard manufactures fittings shall be used in all cases: site fitted saddles are not permitted.

4.13.4 Interallotment drainage system shall be discharged into an underground drainage system or approved open channel. Discharge of interallotment systems to kerbs and channel shall not be permitted.

4.13.5 The depth of the house connection shall be determined as follows (subject to the above minimum);

- 4.13.5.1 Determine the longest run of house drain to the connection point possible within the allotment;
- 4.13.5.2 Allow 0.3 meters cover to the house drain at the head of the line; and
- 4.13.5.3 Allow minimum grade of 1 in 100 for the house drain.

4.13.6 Inspection manholes may be precast or cast insitu concrete boxes or precast FRC or RC pipe systems to the dimensions shown in table D4.4.

Table D4.4 Inspection Manholes

Maximum Depth to invert (mm)	Boxes – internal dimensions (mm)	FRC or RCP Systems
900	600 x 600	600mm diameter
>900	600 x 900	750mm diameter
Minimum wall thickness	100[1]	N/A
Notes: **1. Precast boxes shall be approved prior to installation, wall thickness may vary according to manufacturer.**		

4.13.7 Manholes shall be provided in the following locations:
- 4.13.7.1 One per lot;
- 4.13.7.2 Changes in grade;
- 4.13.7.3 Changes in direction;
- 4.13.7.4 Changes in pipe diameter; and
- 4.13.7.5 End of lines.

DG 4.14 Telemetry Systems

4.14.1 Where required by the Local Authority pump station control panel shall incorporate SCADA equipment for transmission of monitoring data and control to Council's existing master system. Council should be contacted to obtain a copy of their Technical Specification for Telemetry Systems.

4.14.2 It should be noted that where amalgamated Councils have varying telemetry systems, left over from pre-amalgamation Councils, pump station telemetry systems and requirements may vary within that Council and requirements must therefore be reconfirmed as a part of the design.

DG 4.15 Retaining Walls

4.15.1 Where retaining walls are incorporated in the retention of earth batters, adequate drainage shall be incorporated behind the top of the wall to ensure surface stormwater flows do not flow over the top of the wall but are contained in a designed system to pass the wall.

4.15.2 Appropriate scour protection is to be provided to the base of the wall.

4.15.3 Retaining walls within drainage lines must be block and concrete core filled, with weepholes, Design drawings to be provided to Council.

DG 4.16 Detention Basins

4.16.1 Detention basins may be considered as drainage solutions but shall be subject to approval of Council. Where approved detention basins shall be designed in accordance with QUDM.

DG 4.17 Headwalls

4.17.1 Pipe / Box culvert headwalls shall be in accordance with the Department of Transport and Main Roads Standard Drawings 1303 – 1306 and 1318 Proprietary precast headwall may also be used as an alternative to cast insitu structures.

4.17.2 The designer shall ensure that in addition to standard aprons and cut-off walls adequate protection works commensurate with design velocities and flows shall be provided to prevent downstream scouring and erosion.

4.17.3 Where floodgates are to be used, headwalls and aprons shall be specifically designed to accommodate the floodgate and minimise the potential for debris and siltation to impede the operation of the floodgate. Most precast headwalls are not suitable for use with floodgates.

DG 4.18 Table Drains

4.18.1 Table drains shall generally be constructed with a minimum depth of 600mm or to a depth of 300mm below the pavement subgrade, whichever is greater.

4.18.2 Table drain profiles may be either v-shaped or trapezoidal. Reference should be made to the Local Authority Specific Requirements for each Councils preferred profile.

DG 4.19 Easements

4.19.1 Where stormwater drainage pipes pass through property other than a road reserve an easement shall be provided over the line in favour of the Council. The width of this easement is determined by the depth at which the stormwater pipe is laid and based on twice the depth to the pipe obvert plus the pipe diameter (with a minimum width of three (3) metres) and located centrally over the pipe.

4.19.2 If a stormwater pipe passes adjacent to a property and based on the above formula the area of influence passes within the property, an easement over that portion shall be required.

4.19.3 The width of easement shall contain the ARI 100 year storm flow from the upstream catchment or be three (3) metres wide, whichever is greater. 4. Allotment drainage or catch drains which have a change in horizontal alignment greater than 45 degrees shall be provided with concrete or wire-reinforced rock mattresses at such change points which shall be designed to cater for flows in accordance with QUDM.

4.19.4 Easement required over interallotment drainage systems must be built to a level 3 as defined in Q.U.D.M.

4.19.5 The property owner will be responsible for all routine above ground maintenance within interallotment drainage easements. Council shall be responsible for repairs of a capital nature. For example, the property owner must ensure that drainage paths are clear and kept unblocked at all times, such as removing leaves and debris.

DG 4.20 Outlet & Outlet Protection

4.20.1 Outlet into natural watercourse, open channels and tidal areas shall be designed in accordance with the requirements of QUDM.

4.20.2 Protection works to outlet shall be designed to meet the following criteria:

- 4.20.2.1 Dissipate the outflow velocity to minimise scouring;
- 4.20.2.2 Provide protection from stream flows in receiving waters;
- 4.20.2.3 Provide protection from overland (Major Storm) flows into receiving waters; and
- 4.20.2.4 Provide protection from local scouring or undermining of the outlet structure.

4.20.3 Where a headwall is located within the tidal splash zone, it will be designed to comply with the exposure classification requirements of AS 3600.

4.20.4 An energy dissipating outfall shall be provided where the velocity of the outflow or nature of the discharge from the pipe system into the receiving water could cause scouring in the receiving channel.

4.20.5 All tidal outlets shall be fitted with floodgates to prevent the intrusion of salt water into the system.

4.20.6 Outlets with floodgates shall be designed to ensure that they can operate freely at all times, and are protected from siltation, excessive vegetation growth, debris and the impacts of stream flows in the receiving waters.

4.20.7 The designer shall provide calculations to show that they have accounted for losses due to floodgates or other water control devices in the hydraulic design.

4.20.8 All outlets shall be located to facilitate inspection and maintenance access.

DG 5 – DESIGN GUIDELINES – Water Reticulation

General

DG 5.1 Scope

5.1.1 This document sets out the acceptable solutions for the planning, design and construction of water reticulation systems that are to be constructed by a Developer and handed to Council to operate. This section also covers certain service connection issues relating to development approvals and private infrastructure that needs to be to Council standards.

5.1.2 The water reticulation system shall be defined as mains less than 300mm diameter. Design of mains 300mm diameter and greater shall be subject to the specific criteria nominated by Council. All mains less than 300mm diameter shall be designed in accordance with this manual.

5.1.3 No connections will be permitted to bulk water supply mains that are used for the sole purpose of bulk water transfer of water to water reservoirs.

5.1.4 The planning, design, construction and certification of water reticulation infrastructure is to be carried out in accordance with the following provisions:

- 5.1.4.1 Council's general criteria as set out in these manuals and Council's Standard Specifications and Drawings that are based on the Desired Standards of Service;
- 5.1.4.2 The criteria contained within the Water Services Association of Australia WSA 03 – 2011 – Water Supply Code of Australia;
- 5.1.4.3 The designer shall note the Queensland Workplace Health and Safety – Guide to the Workplace Health and Safety Obligations of Designers of Structures and the design shall include the required Safety Design Report; and
- 5.1.4.4 For general guidance on infrastructure elements not contained within council's documents, the criteria contained within the Department of Energy and Water Supply Planning Guidelines for Water Supply and Sewerage may be used for guidance.

5.1.5 Aspects of modification or clarification of the Water Supply Code of Australia WSA 03 – 2011 are detailed in Appendix B of this document.

5.1.6 Council's Land Development Guidelines and Standard Specification and Drawings shall take precedence over the Water Services Association of Australia Codes and the Department of Energy and Water Supply Planning Guidelines for Water Supply and Sewerage.

DG 5.2 General

5.2.1 It is the Consulting Engineer's responsibility to ensure that the current version of this section is used and that all infrastructure is constructed in accordance with this section.

5.2.2 It is the Consulting Engineer's responsibility to ensure that all work is undertaken to council's requirements. Responsibility for supervision, testing, inspection, commissioning and remedial work rests with the Consulting Engineer.

5.2.3 Where a water supply source is being developed to service the development, the source shall either meet or exceed the Australian Drinking Water Guidelines 2011 (ADWG), or the developer shall provide the necessary infrastructure to treat the source to the ADWG, including disinfection before storage and/or distribution.

DG 5.3 Objective

5.3.1 The objective of a water supply system is to provide to the consumer a reticulated portable water supply to meet the demands imposed upon it by both the consumers and fire-fighting requirements.

DG 5.4 Reference Documents

5.4.1 Australian Standards:
- 5.4.1.1 AS/NZS 2566 Buried Flexible Pipelines
- 5.4.1.2 AS 2368 Test Pumping of Water Wells
- 5.4.1.3 AS 3952 Water Supply – Spring Hydrant Valve for Waterworks Purposes

5.4.2 National Health and Medical Research Council

5.4.3 Australian Drinking Water Guidelines

5.4.4 QLD Government Legislation
- 5.4.4.1 Water Act
- 5.4.4.2 Water Supply (Safety and Reliability) Act Water Services Association of Australia
- 5.4.4.3 WSA 03 – 2011 – Water Supply Code of Australia
- 5.4.4.4 WSA 01 –2004- Polyethylene Pipeline Code Information and Guidance Note
- 5.4.4.5 WSA-TN4 Guidelines for design of pressure pipeline systems for water supply using PVC-M and PVC-O pipes

5.4.5 Department of Energy and Water Supply
- 5.4.5.1 Planning Guidelines for Water Supply and Sewerage National Uniform Drillers Licensing Committee 2012
- 5.4.5.2 Minimum Construction Requirements for Water Bores in Australia

DG 5.5 General

5.5.1 All connections or alterations to Council water reticulation mains shall be made by the Developer at the Developers cost and subject to appropriate conditions agreed with Council.

5.5.2 The design of the water reticulation will take into consideration all external demands that are presently acting on the system or are likely to do so in the future. Council shall be consulted to ascertain these external demands, points of connection to existing reticulation and operating parameters.

5.5.3 Council approval of water reticulation does not relieve the Consulting Engineer of responsibility for the design.

5.5.4 In staged developments, to ensure an efficient distribution system is established, the designers are required to submit to the Council an overall layout of the proposed subdivision, including all stages demonstrating that each stage of the development achieves minimum pressures and showing the sizing of mains to be incorporated. This proposal shall be submitted to the Council for approval in principle before the submission of any construction plans and specifications will be accepted for review.

5.5.5 Prior to proceeding with detailed design, the Consultant shall liaise with Council to ascertain whether a network analysis (to determine the optimum size of the internal mains) is required by Council as part of the design submission for the development. For the design of water reticulation schemes and where Council requires a network analysis, it shall be completed by the Consultant at the Developers cost following discussions with Council and be based on the design criteria detailed in Section DG5.7 below.

5.5.6 If a network analysis is required, the designer will be required to provide digital data compatible with Councils software, with the design submission, to enable the reticulation network to be input into Council's network model for checking. The network analysis shall be undertaken for the total development using Bentley WaterCAD compatible software and available for handover to Council for incorporation into the Council network program.

5.5.7 The network analysis shall be based on the design drawings and be spatially accurate.

5.5.8 In sloping development sites, the water reticulation network is to be designed in pressure zones to allow Council to control maximum and minimum pressures within the development.

5.5.9 The network design shall be planned to satisfy the requirements of this manual and to meet Council Customer Service Standards, which are published pursuant to the requirements of the Water Supply (Safety and Reliability) Act 2008, at a minimum whole-of-life cost (capital cost, operational and maintenance cost) for an environmentally acceptable solution and not simply a least capital cost solution. 8. Refer to Appendix D Whitsunday Regional Council Standard Conditions for Water Supply Above RL50.

DG 5.6 Existing Mains

5.6.1 Council should be contacted to obtain copies of any "As Constructed" plans and details of any planned augmentation works.

5.6.2 Where, as a result of the development, existing mains are located on non-standard alignments or have less than minimum cover, the developer shall bear the cost of relocation, replacement or lowering, subject to the approval of the Council.

5.6.3 Pavement widening associated with some developments can place existing mains under the new pavement. In such cases, where the existing main has inadequate cover, the developer shall bear the cost of its replacement in a material approved by the Council, or reconstruction at an adequate cover depth or reconstruction on a standard alignment in the new verge.

DG 5.7 Design Criteria

5.7.1 Flow Parameters - unless advised otherwise by Council, the Average Daily consumption and peaking factors for the design of Water Supply Schemes shall be as follows:

5.7.1.1 Average Daily Consumption (AD) 500 litre/person/day

5.7.1.2 Mean Day max Month (MDMM) 1.50 x AD Peak Day (PD) 2.25 x AD

5.7.1.3 Peak Hour (PH) 1/12 x PD

5.7.2 In the absence of specific flow consumption data, the Average Daily Consumption shall be calculated using the equivalent demands shown in Table 6.1.

Table 6.1 Equivalent Demands

Description	Equivalent Persons/Connection
Single Family Dwelling	
Lots > 1500m^2	3.7
Lots 1101 – 1499m^2	3.4
Lots 901 – 1100m^2	3.1
Lots 401 – 900m^2	2.8
Lots <400m^2	2.5
Multi Unit Accommodation	
Units > 3 bedrooms	0.4 + 0.6/bedroom
Units = 3 bedrooms	2.2
Units = 2 bedrooms	1.6
Units < 2 bedrooms	1.0
Caravan Parks	
Van Site / Camping Site	1.2
Shops/Offices	
Per 90m^2	1.0
Notes:	

1. **Based on 2.8 Equivalent Persons/Equivalent Domestic Connection (EP/EDC), with 1 EDC equivalent to a single residential dwelling on a standard size allotment (401m^2 to 900m^2).**
2. **For undeveloped land equivalent populations shall be calculated in accordance with the maximum allowable population density in the Planning Scheme, or estimation of maximum allowable density agreed with Council prior to design.**

5.7.3 Pressure Parameters – minimum and maximum service Pressures (excluding fire-fighting) – see table 6.2.

Table 6.2 – Pressure Parameters

Requirement	Details
Minimum Pressure	22 metres head at peak hourly consumption
Minimum Pressure Location	At the property boundary for all lots
Minimum Pressure Network Condition (for modelling from a reservoir).	Based on the reservoir level for Peak Hour of the third day of three consecutive Peak Day events (for dynamic models). In the absence of dynamic model results the minimum reservoir level shall be assumed at 15% of storage height. Liaise with Council to confirm minimum pressure constraints available at the connection to the existing system.
Maximum Pressure	80 metres head. Where the pressure in a main exceeds 800 kPa, Council may require the installation of Pressure Reducing Valves (PRV) that may (at Council's discretion) include telemetry control. Prior to proceeding with any design, Council shall be provided with details of the area affected and the number of lots involved.
Maximum pressure location	At the lot boundary
Maximum Pressure Network Condition (for modelling from a reservoir).	Based on reservoir level at 95 percent of top water level.

5.7.4 Fire Fighting Parameters

Table 6.3 – Fire Fighting Parameters

Category	Fire Flow Requirement	Number & Duration
Residential (i.e. An area comprising of predominantly residential dwellings of a maximum of 3 storeys)	15 L/s for 2 hours	1 @ 2 hours
Commercial (i.e. An area comprising of shop and office accommodation of a maximum of 3 storeys) and Industrial	30 L/s for 4 hours For schemes serving a population of less than 1000 a fire flow of 15 L/s for 2 hours should be satisfactory except where a special hazard or risk development exists	1 @ 4 hours
High Risk (i.e. A development where there is a probability of a fire occurring or there is a high cost of resultant damage (personal injury or property))	To be determined	Adopt a special hazard or risk fire
Residual pressure plan is to be 12m minimum at hydrant at all times, assuming that the elevation of the supply point is equal to the ground elevation at the hydrant. Positive residual pressures must exist within the reticulation during the fire event.		

5.7.5 Background Demand - the following minimum criteria should be adopted for background demand during a fire event:

5.7.5.1 Predominantly Residential Areas:

5.7.5.1.1 The minimum residual pressure specified should be exceeded with a background demand of 2/3 Peak Hour demand;

5.7.5.1.2 A check should be undertaken at Peak Hour demand to ensure that pressures in the network remain positive; and

5.7.5.1.3 The calculated background demand should not be less than Average Day demand.

5.7.5.2 Predominantly Commercial / Industrial Areas – In this case, the following scenarios should be investigated with the worst case being adopted:

5.7.5.2.1 At Peak Hour demand of the Commercial / Industrial area (e.g. between 10am to 4pm). The intent of this scenario is to assess the local reticulation performance; and

5.7.5.2.2 At 2/3 Peak Hour demand of the water supply zone (e.g. around 6pm). The intent of this scenario is to assess the zone trunk performance.

5.7.5.3 Mixed Residential / Commercial / Industrial Areas – In such cases a combination of background demand conditions similar to the Predominantly Commercial / Industrial Areas above should be examined.

5.7.6 Storage Parameters – refer table 6.4.

Table 6.4 – Storage Parameters

Component	Sizing
Reservoirs (Ground Level)	3 (PD-MDMM) + (greater of Emergency Storage/Firefighting Storage)
Reservoirs (Elevated)	$6\ (\frac{PH - MDMM}{12})$ + firefighting reserve

5.7.7 Pump Parameters – refer table 6.5.

Table 6.5 – Pump Parameters

Design type		Parameters
Treated water pumps feeding a ground level reservoir		MDMM over 20 hours
Treated water pumps feeding an elevated reservoir		Capacity (L/s) = $\frac{6PH - \text{reservoir operating volume}}{6 \times 3600}$ (Volume in litres)
Standby Pumps		Standby pump capacity to match the largest single unit pump capacity
Reticulation booster pump station		PH + fireflow
Pumped System	Peak Instantaneous flow + fireflow	This situation may exist in smaller systems if variable speed pumps would replace any elevated storage. In these instances, it would be necessary to calculate instantaneous flow based on concurrent demand. This would exceed PH by a significant margin

5.7.8 Pipeline Parameters

Table 6.6 Pipeline Parameters

	Parameter
Pipe Capacity – trunk & reticulated mains	Size for PH + Fire Flow
Friction Equation	Hazen-Williams
Maximum Velocity	2.5m/s velocities up to 4.0m/s may be acceptable during fire flows
Minimum Velocity	N/A

5.7.9 Headloss Calculations - For headloss calculations, the Hazen-Williams formula is generally used. Values of the Hazen Williams friction co-efficient (C) to be adopted are as per table 6.7.

Table 6.7 Headloss Calculations

Pipe Diameter (D)	C Value
D ≤ 150mm	100
150mm < D ≤ 300mm	110
300mm < D ≤ 300mm	120
D > 600mm	125
Note: The above values take into account losses for pipe fittings such as bends, valves, tees, crosses etc and the effect of pipeline ageing.	

5.7.10 Road Crossing

5.7.10.1 all road crossings shall be minimum 100mm diameter;

5.7.10.2 all road crossings under Council controlled roads shall be constructed in Ductile Iron; and

5.7.10.3 all Road crossings under Industrial Roads, Major Collectors or higher order roads shall be constructed with an isolation valve each side of the road.

DG 5.8 Dedication of Land Easements & Permits to Enter

5.8.1 General Infrastructure - All pumping stations, booster stations, storage tanks, reservoirs, water towers and the like are to be located on freehold land that is owned by or will be dedicated to Council at the time of plan sealing, except that small pumping stations may, with State Government's approval, be located in land that is or will become road reserve. This land shall be provided to Council at no cost as freehold and zoned for water infrastructure purposes; and

5.8.2 Pumping Stations not sited beside a road reserve are to be provided with a 5-metre wide access transferred to Council as freehold.

5.8.3 When pipelines and appurtenances relating to pipelines are constructed in land other than in what is or will become, a dedicated road reserve or property owned by Council, Council requires easements to be registered in its favour over all such pipelines and appurtenances;

5.8.4 Easements shall be a minimum of 3 metres wide and located centrally over the pipeline. Mains are to be no closer than 1 m from an easement boundary; and

5.8.5 In the event that works are to be constructed through properties not under the control of the Developer, the Developer shall submit with the Operational Works Application:

5.8.5.1 A 'Permit to Enter & Construct' letter, signed by each property owner through whose property the infrastructure is to be constructed, consenting to the construction of the works;

5.8.5.2 Where the property is owned or to be dedicated to Council approval of the relevant section of Council that will manage the property; and

5.8.5.3 Proof of the registration of easements in favour of Council as specified above.

DG 5.10 Reticulation Network

5.10.1 All water mains shall be laid on a standard alignment and unless directed otherwise alignments shall be as follows:

5.10.1.1 Urban – 2.5m

5.10.1.2 Rural – 2.5m

5.10.2 Bending of pipes is not permitted notwithstanding any clause to the contrary in the WSA Code.

DG 5.11 Cover

5.11.1 Unless noted otherwise on the approved Project Drawings the minimum depth of cover to be provided for mains shall be as follows:

5.11.1.1 Verge, Parks etc. 600mm

5.11.1.2 Under Kerbed Roads 800mm

5.11.1.3 Under Un-Kerbed Roads 900mm

5.11.2 The maximum depth of cover to be provided for mains shall be 1500mm.

DG 5.12 Hydrants

5.12.1 Hydrants shall be installed for fire-fighting purposes on all potable water mains unless approved otherwise by Council.

5.12.2 Generally, hydrants shall be at 80m maximum centres for all urban areas and wherever possible located opposite allotment boundaries, and at every second allotment boundary for Rural, Park Residential and Low Density Residential allotments.

5.12.3 Hydrants shall be located at ends of lines in cul-de-sacs opposite the nearest allotment boundary.

5.12.4 Hydrants shall be located near access legs of battle-axe or hatchet shaped allotments.

5.12.5 Staged developments resulting in temporary dead ends shall have a hydrant located within close proximity to the end of line to enable maintenance flushing.

5.12.6 In undulating areas, hydrants should also be positioned at all high and low points of the main.

5.12.7 Hydrants shall be constructed in accordance with Council's Standard Drawings.

DG 5.13 Valves

5.13.1 Valves shall be located opposite the first truncation point at a three-way intersection; or opposite the nearest allotment boundary.

5.13.2 All valves shall be located within the verge. Valves shall only be located within the road carriageway where specifically approved by Council.

5.13.3 Valves shall be installed where necessary to isolate sections of the system for maintenance purposes such that maintenance can be carried out causing minimum inconvenience and disturbance to the consumers. Generally, the design is to ensure that no more than 4 valves are required to be turned off to isolate a section with the maximum number of houses inconvenienced should be no greater than 20.

5.13.4 Cul-de-sacs shall have an isolation valve if more than 4 lots are served.

5.13.5 At tee junctions a valve shall be located on the leg of the tee. Where necessary to achieve maintenance isolation requirements, additional valves shall be installed to one or both sides of the tee junction.

5.13.6 The maximum spacing between isolation valves shall be 300m.

5.13.7 In higher density areas the spacing of isolation valves may be reduced to the requirement of the Council.

5.13.8 Valves shall be constructed in accordance with Council's Standard Drawings.

DG 5.14 Irrigation

5.14.1 All irrigation systems connected to Council's water supply shall be installed to satisfaction of Council. The installation of water meters, RPZ backflow prevention device and isolation valves are mandatory in all irrigation system. Refer Design Manual D9 Landscaping for design of irrigation systems.

5.14.2 A hydraulic design certificate is required for the irrigation system and to ascertain the required service size.

5.14.3 All connections to Council's existing system shall be completed by the Developer at the Developer's cost and subject to appropriate conditions agreed with Council.

Pump Stations

DG 5.15 General

5.15.1 Pump stations shall be subject to specific requirements of the local authority. Council should be consulted prior to design to confirm the specific requirements for pumps, electrical, switchboards, telemetry, etc.

5.15.2 Council acceptance of pump station design does not relieve the Consulting Engineer of responsibility for the correctness of the design.

DG 5.16 Pump Stations

5.16.1 Pump stations are to be contained in an above ground structure. The structure is to be constructed from reinforced masonry block and/or reinforced concrete. The structure is to be sized to allow for adequate internal access to all items for operational control but particularly for maintenance works. Openings will allow the easy reach and replacement of the largest item contained in the pump station. The use of multistage/centrifugal pumps is preferred.

5.16.2 A back-up power supply is to be provided either by a generator or diesel pump unless a five (5) day reservoir capacity is provided. Suitable arrangements for ducting airflow to the generator / diesel pump and the disposal of exhaust gases so as not to create a nuisance is required. Sufficient fuel is to be stored to operate for 12 hours at rated load (at AD demand).

5.16.3 Noise suppression is to be addressed and incorporated into the pumps station design. The pump station design is to comply with the Environmental Protection Act during normal use.

5.16.4 The tenure of property on which pump stations and access roads are situated are to be transferred to Council as freehold title. Pump station sites are not to encroach upon gazetted road areas unless otherwise approved by Council.

5.16.5 Access to the pump station site is to be via an appropriate standard sealed access and the pump station site is to accommodate maintenance vehicles and their manoeuvring.

5.16.6 Internal and external pump station surfaces are to be painted as directed.

DG 5.17 Telemetry Systems

5.17.1 Where required by the Local Authority, pump station control panel shall incorporate SCADA equipment for transmission of monitoring data and control

to Council's existing master system. Council should be contacted to obtain a copy of their Technical Specification for Telemetry Systems.

5.17.2 It should be noted that where amalgamated Councils have varying telemetry systems, left over from pre-amalgamation Councils, pump station telemetry systems and requirements may vary within that Council and requirements must therefore be reconfirmed as a part of the design.

DG 5.18 Alternative Water Pumping Systems

5.18.1 Alternative water pumping systems to provide increased pressures and flows to individual developments in lieu of a water storage reservoir may be considered by Council if sufficient justification can be provided. Such systems should generally include a number of centrifugal pumps installed in parallel and coordinated by a pump controller, which senses, and responds to water demand. The controller shall also regulate the pump speed to give a graduated increase or decrease in the volume of water being supplied and evenly shares the work between pump units.

5.18.2 In general, Council will only permit the use of such booster pump stations where all of the following conditions apply:

- 5.18.2.1 Where Council considers it impractical to build a storage reservoir for topographical, geotechnical, or aesthetic reasons;
- 5.18.2.2 Where a reservoir would service only that particular development;
- 5.18.2.3 Where the number of lots to be serviced by the booster pump station is less the 25; and
- 5.18.2.4 Where the booster pump station building can be blended with the architectural style of residences within the development.

5.18.3 The consultant should submit an initial report and associated recommendations for consideration by Council prior to any detailed design. As a minimum the report should include:

- 5.18.3.1 Reason for and benefits to the community based on the total life cycle costs of an alternative water pumping system;
- 5.18.3.2 Connection points to the existing system;
- 5.18.3.3 Water supply schematic plan;
- 5.18.3.4 Maintenance issues; and
- 5.18.3.5 Environmental reasons.

DG 5.19 Dual Water Supply Systems

5.19.1 The Dual Water Supply System comprises Water Supply Code WSA 03-2011 and the Whitsunday Regional Council Amendments (Appendix B) to the above supplement.

5.19.2 Appendix C describes Whitsunday Regional Council's specific requirements for Dual Water Supply System works up to and including DN 300 that vary from or are additional to those detailed in the Water Supply Code WSA 03-2011.

DG 5.20 Private Boosters

5.20.1 Written approval for the use of private boosters must be obtained from Council.

DG 5.21 Conduits

5.21.1 A conduit shall be provided to all landscaped or grassed Medians, Traffic Islands and Roundabout islands to facilitate a future water service connection for landscaping purposes.

5.21.2 Where the length of a median exceeds 50m, conduits shall be provided at 50m centres. At roundabouts and channelised intersections the conduit layout should enable all landscape islands to be connected to a single water service connection.

5.21.3 Conduits under roadways shall be a minimum 100mm dia. uPVC Class 9 sealed each end with push-on caps.

5.21.4 Cover to conduits under roads shall be 600mm minimum or 100mm below subgrade, whichever is the greater.

5.21.5 The position of all conduits under roadways shall be clearly marked by the casting a nonferrous cuphead bolt into of the top of the kerb.

5.21.6 Where concrete footpaths are constructed on the road verge and the future water service connections are not being provided, a conduit shall be provided under the footpath opposite the allotment boundary to facilitate the future installation of water services by Council. Generally, water services shall be located at an alternate boundary to Ergon Energy's pillar box. Exceptions may be considered in individual circumstances were unusual conditions or lot layouts exist and where approved by Council and Ergon Energy.

5.21.7 Conduits under footpaths shall be a minimum 80mm dia. uPVC Class 6 with 300mm cover and are to extend 300mm past the edge of the footpath. The position of all conduits under footpaths shall be clearly marked by casting a non-ferrous cuphead bolt into the property side of the footpath while the concrete is wet.

DG 6 – DESIGN GUIDELINE – Sewerage System

General

DG 6.1 Scope

6.1.1 This document sets out the minimum standards for the planning and design of sewer reticulation systems that are to be constructed by a Developer and handed to Council to operate. This section also covers certain service connection issues relating to development approvals and private infrastructure that need to be to Council standards.

6.1.2 The sewer reticulation system shall be defined as sewers of 150mm and 225mm diameter, used to collect and convey sewage from properties. Designs for sewers larger than 225mm diameter shall be subject to specific criteria nominated by the Council. All sewers 225mm diameter or less shall be in accordance with this manual. This definition of sewer reticulation systems applies only to these Whitsunday Regional Council Sewerage Design Manual and Specifications and is independent of the definition of trunk infrastructure as relates to trunk infrastructure charges.

6.1.3 Wherever possible, development should avoid the use of sewerage pump stations when a gravity solution is available. If a pump station is the only option, a buffer zone and screening should be given to the nearest private property.

6.1.4 The planning, design, construction and certification of infrastructure is to be carried out in accordance with following provisions:

- 6.1.4.1 Council's general criteria as set out in this manual and Council's Standard Specifications and Drawings that are based on the Desired Standards of Service;
- 6.1.4.2 The criteria contain within the Water Services Association of Australia (WSAA) publications identified in D7.4. While vacuum and pressure sewer scheme WSA codes are listed, they are still considered unconventional infrastructure –refer D7.7;
- 6.1.4.3 The designer shall note the Queensland Workplace Health and Safety – Guide to Workplace Health and Safety Obligations of Designers of Structures and the design shall include the required Safety Design Report; and
- 6.1.4.4 For general guidance on infrastructure elements not contained within council's documentation, the criteria contained with the Department of Energy and Water Supply Planning Guidelines for Water Supply and Sewerage may be used for guidance.

6.1.5 Aspects of modification or clarification of the Water Services Association of Australia codes are detailed in Appendix E of this manual.

6.1.6 Council's Land Development Guidelines and Standard Specification and Drawings shall take precedence over the Water Services Association of Australia Codes and the Department of Energy and Water Supply Planning Guidelines for Water Supply and Sewerage.

6.1.7 Smart Sewers are considered Unconventional Infrastructure. Smart Sewer planning, design, construction and certification may be carried out in accordance with Queensland Urban Utilities Sewerage Standards – Nu Sewer – Design and Construction Specification Version 6 and aspects of modification or clarification within the manual and approved by Council.

6.1.8 For construction standards for Electrical Switchboards for Sewage Pumping Stations, refer Appendix J – Addendum to Sewer Pumping Code.

DG 6.2 General

6.2.1 It is the Consulting Engineer's responsibility to ensure that the current version of Whitsunday Regional Council Development Manual is used and that all infrastructure is constructed in accordance with this section as a minimum standard.

6.2.2 It is the Consulting Engineer's responsibility to ensure that all work is undertaken to council's requirements. Responsibility for supervision, testing, inspection, commissioning and remedial work rests with the Consulting Engineer.

DG 6.3 Objective

6.3.1 The objective of the sewerage system is to transport sewage from domestic, commercial and industrial properties using gravity flow pipes and, where gravity system is not possible by pumping to the treatment plant.

6.3.2 While various options can be determined that meet the minimum technical requirements, the selected option should meet least community cost for whole lifecycle. To achieve the optimum solution will require sewerage reticulation issues to be considered at the commencement of the planning process and to integrate with other planning issues, and not be considered an end of process infrastructure provision exercise.

DG 6.4 Reference Documents

6.4.1 Australian Standards:
- 6.4.1.1 AS/NZS 1547-2012 On-site domestic wastewater management.
- 6.4.1.2 AS/NZS 3500-2013 Plumbing and drainage set

6.4.2 Council Approved Products Register

6.4.3 QLD Government Legislation:
- 6.4.3.1 Water Act 2000
- 6.4.3.2 Water Supply (Safety and Reliability) Act 2008
- 6.4.3.3 Plumbing and Drainage Act 2002
- 6.4.3.4 Queensland Plumbing and Wastewater Code

6.4.4 Water Services Association of Australia:
- 6.4.4.1 WSA 02-2014 Gravity Sewerage Code of Australia
- 6.4.4.2 WSA 04-2005 Sewerage Pumping Station Code of Australia

6.4.4.3 WSA 05-2013 Conduit inspection Reporting Code of Australia
6.4.4.4 WSA 06-2008 Vacuum Sewerage Code of Australia
6.4.4.5 WSA 07-2007 Pressure Sewerage Code of Australia
6.4.4.6 WSA 01-2004 Polyethylene Pipeline Code

6.4.5 Department of Energy and Water Supply's - Planning Guidelines for Water Supply and Sewerage

Design Criteria

DG 6.5 General

6.5.1 Sewers shall be designed to accommodate flows from upstream catchments, calculated on the basis of their future development in accordance with Council's Strategic Plan, and accordingly, shall be extended to the upstream boundary(ies) of the proposed development (where required) to service upstream properties with the least whole of life cost. Designers should consult with Council to confirm location of any future connections points, details of any planned augmentation works and sewerage catchment areas.

6.5.2 Council approval of sewerage reticulation does not relieve the Consulting Engineer of responsibility for the correctness of the design.

6.5.3 In staged developments, to ensure an efficient distribution system is established, the designers are required to submit to the Council an overall layout of the proposed subdivision, including all stages, showing the sizing of mains to be incorporated. This proposal shall be submitted to the Council for approval in principle before the submission of any construction plans and specifications will be accepted for review. Refer to Application Procedures.

DG 6.6 Existing Sewers

6.6.1 Prior to proceeding with the design, the designer shall obtain from Council "As Constructed" sewer information relevant to the proposed development and confirm point(s) for connection.

6.6.2 Works associated with some developments can impact on existing mains. Where as a result of the development an existing main has inadequate cover, it shall be reconstructed with a material approved by the Council or such other alternate protection measures deemed necessary by Council. Subsequent to construction, CCTV and/or ovality Testing is to be undertaken as determined by Council after the completion of works in accordance with this Manual and supervised by a Council Representative.

6.6.3 Where finished surface levels around existing manhole covers are altered, the manhole shall be reconstructed to conform with the requirements of this manual.

6.6.4 All connections or alterations to Council sewerage network, shall be made by the Developer at the Developers cost and subject to appropriate conditions agreed with Council.

DG 6.7 Unconventional Infrastructure

6.7.1 Conventional infrastructure includes gravity sewers, lift stations, area pumping stations and pressure (rising) mains. Unconventional infrastructure includes smart sewers, small bore systems of any kind, including vacuum systems, hybrid low pressure systems, common effluent drainage systems, grinder pumps serving small clusters of properties and the like, and any other unconventional or unusual systems.

6.7.2 The use of unconventional infrastructure shall require special approval by Council and may require extended maintenance periods and a higher value for performance bonds.

6.7.3 In unconventional systems, Council may not have approved design criteria. Accordingly, proposals will be considered on the basis of best engineering practice and are to be subject to a lifetime benefit cost analysis.

6.7.4 If unconventional infrastructure is proposed the Consultant shall submit an initial report and associated recommendations for consideration by Council prior to any detailed design. The report should include as a minimum:

- 6.7.4.1 Description of proposed infrastructure;
- 6.7.4.2 Reasons for departing from Conventional systems;
- 6.7.4.3 Reasons for and cost benefits to Council;
- 6.7.4.4 Connection points to existing system;
- 6.7.4.5 Schematic layout plan; and
- 6.7.4.6 Maintenance and operational issues.

6.7.5 Subject to Council's assessment of the Consultant's initial report and prior to any detailed design, Council may engage an independent Consultant to act for Council in assessing the initial report and to recommend suitable system parameters.

6.7.6 All costs associated with the engagement of the independent Consultant shall be at the Developers expense.

6.7.7 Any subsequent designs of infrastructure shall be planned to satisfy the requirements to meet Council Customer Service Standards, which are published pursuant to the requirements of the Water Supply (Safety and reliability) Act, at a minimum whole-of-life cost (capital cost, operational and maintenance cost) for an environmentally acceptable solution and not simply a least capital cost solution.

DG 6.8 Design Criteria

6.8.1 Capacity – population estimates shall be based on those equivalent demands detailed in Table 6.1; and

6.8.2 The minimum pipe capacity shall be based on the criteria detailed in Table 6.2.

Table 6.1 Equivalent Demands

Description	Equivalent Persons/Connection
Single Family Dwelling	
Lot > 1500m^2	3.7
Lot 1101m^2 to 1500m^2	3.4
Lot 901m^2 to 1100m^2	3.1
Lot 401m^2 to 900m^2	2.8
Lot <400m^2	2.5
Multi-Unit Accommodation	
Units > 3 bedrooms	0.4 + 0.6/bedroom
Units = 3 bedrooms	2.2
Units = 2 bedrooms	1.6
Units < 2 bedrooms	1.0
Caravan Parks	
Van Site / Camping Site	1.2
Shops/Offices	
Per 90m^2 GFA	1.0

Notes:

1. **Based on 2.8 Equivalent Persons / Equivalent Domestic Connection (EP/EDC) with 1 EDC equivalent to a single residential dwelling on a standard size allotment (401m^2 to 900m^2)**
2. **For undeveloped land equivalent populations shall be calculated in accordance with the maximum allowable population density in the Planning Scheme for that land use, or estimation of maximum allowable density agreed with Council prior to design.**

Table 6.2 Sewerage Loading

Average Dry Weather Flow (AWDF)	270/EP/d	Based upon analysis of pump station flows and STP inflow records during dry weather
Peak Wet Weather Flow (PWWF)	5 x ADWF or C^1 x ADWF whichever is greater	C^1 Peaking Factor = 15 x (EP)(^-0.1587) Note - Minimum value C^1 to be 5

Peak Dry Weather Flow (PDWF)	C^2 x ADWF	C2 Peaking Factor = 4.7 x (EP)-0.105
Vacuum Sewer Peak Wet Weather Flow (PWWF)	4 x ADWF	Peaking Factor of 4
Smart Sewer Peak Wet Weather Flow (PWWF)	4 x ADWF	Peaking Factor of 4

6.8.3 Pipe velocity shall be based on the details show in Table 6.3

Table 6.3 Pipe Velocities

Design Criteria	Recommended Value
Mannings 'n' (PVC)	0.013
Mannings 'n' (Poly)	0.013
Minimum Velocity @ PWWF	0.6m/s
Minimum Velocity @ PDWF	0.3m/s
Depth of Flow @ PWWF – Proposed Sewers	Max Flow depth shall not exceed ¾ pipe full

6.8.4 Minimum grades for sewer reticulation mains are to be as summarised in Table 6.4

Table 6.4 Minimum Grades for Gravity Sewers

Diameter	Minimum Grade	Minimum Grade Percentage
100mm – Property Connection Branches	1 in 60	1.66%
150mm – Property Connection Branches	1 in 80	1.25%
150mm – First MH Length, head of sewer	1 in 100	1.00%
Second MH Length	1 in 150	0.67%
Remaining MH Lengths	1 in 150	0.67%
225mm	1 in 290	0.34%
300mm	1 in 420	0.24%
375mm	1 in 570	0.18%
450mm	1 in 730	0.14%
525mm	1 in 900	0.11%
600mm	1 in 1000	0.10%
675mm	1 in 1200	0.08%
≥ 750mm	1 in 1500	0.07%

6.8.5 The maximum allowable Equivalent Domestic Connections for various gravity sewer pipeline grades and diameters is listed in Table 6.5 below.

Grade	150 diameter	225 diameter	300 diameter	375 diameter
570				1530
550				1557
500				1633
450				1721
420			983	1782
400			1007	1826
350			1076	1952
300			1163	2108
290		549	1183	2144
250		591	1274	2310
200		661	1424	2582
180	236	697	1501	2722
150	259	763	1644	2982
125	284	836	1801	3266
100	317	935	2014	3652
75	366	1080	2325	4217
50	448	1322	2848	5164

6.8.6 Sewer Depths – sewers shall not be greater than 3m deep unless approved by Council.

6.8.7 Where sewers are greater than 3m deep, the consultant engineer must submit calculations demonstrating sufficiency of the strength of the proposed pipe type and trenching condition.

DG 6.9 Sewer Alignment

6.9.1 The preferred, or standard, alignment of sewer lines in relation to property boundaries is presented in Table 6.6.

Table 6.6 Preferred Alignment of Sewers

Location	Alignment
Carriageway	Not Permitted, crossings only
Verge	Not usually permitted, subject to Council approval
Private Property (other than Commercial property)	
Side Boundary	0.8m inside allotment
Front and Rear Boundary	1.5 inside allotment
Commercial Boundary	
Front Boundary	1.5m inside front of allotment

6.9.2 Where sewer lines are located along the road frontage of allotments, the preferred alignment is 1.5m inside the allotment. However, to reduce the number of manholes on curved roads and where truncations occur, the sewer alignment may be varied slightly subject to Council approval.

6.9.3 Where the allotment is located adjacent to a designated Council Park or Drainage Reserve, and the sewer is proposed to be constructed adjacent to the Park or Drainage Reserve boundary, the sewer shall be constructed on a 0.8m alignment and wholly within the Park or Drainage Reserve. Where the sewer is proposed to be located elsewhere in the park, approval for the location must be obtained from Council.

6.9.4 Where sewers are to be located within existing road reserves, the designer shall check that the sewers do not conflict with other utility services and locate the sewers to the satisfaction of Council and in accordance with the services clearances as set out in WSA 02-2014 5.4.

6.9.5 Where retaining walls are located on or near the boundary of allotments, sewers, property connection points, manholes etc. must not be constructed under or within the zone of influence of the retaining wall foundations. Consideration is to be given to the difficulty of maintenance excavation on the lower side of retaining walls.

6.9.6 Where access for persons is required, adequate clearance must be provided around access structures and property connection points. For access structures, an area within a 1.5 metre radius (on three sides to permit the set up and use of confined space equipment and other maintenance equipment such as jet rodders and remote cameras) must be provided around the central point of the facility.

6.9.7 Stubs must be extended a minimum of 0.5m past the property boundary.

DG 6.10 Manholes

6.10.1 Manholes shall be placed on gravity sewers at the following locations:

- 6.10.1.1 At changes of pipe diameter;
- 6.10.1.2 At ends of lines where ends are more than 30m from previous manhole;
- 6.10.1.3 At ends of lines where the line depth is greater than 1.5m;
- 6.10.1.4 At end of lines servicing greater than one Property Connection Branches; and
- 6.10.1.5 At council approved connections to trunk sewer.

6.10.2 Manhole shall not be constructed across property boundaries. Minimum clearance from the edge of manhole to the property boundary shall be 400mm.

6.10.3 The maximum change of angle through a manhole shall be 90° unless specifically approved otherwise by Council.

6.10.4 Manholes shall be constructed in accordance with the Standard Drawings S-0020 – S-0026.

6.10.5 Rectangular covers shall be provided to manholes less than 1500mm deep measured from the top of the manhole cover to the obvert level of the outlet.

This has been derived so that a minimum 1.0m high clear working space is available within the manhole.

6.10.6 End of line treatments/alternatives may be acceptable as determined by Council.

DG 6.11 Covers and Surrounds

6.11.1 Manhole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces. Elsewhere, unless noted otherwise on the approved Project Drawings, covers shall be finished 50mm above the surface of the ground, in a manner designed to avoid as far as possible, the entry of surface water.

6.11.2 Manhole covers are to be gas tight.

6.11.3 Manhole covers are to be located such that the position of the access opening is directly over the outlet pipe.

6.11.4 The installation of all precast manhole covers shall be in accordance with the manufacturers' recommended procedures and requirements and subject to appropriate conditions agreed with Council.

DG 6.12 Dedication of Land, Easements and Permits to Enter

6.12.1 General Infrastructure –

6.12.1.1 All pumping stations, lift stations, storage tanks and the like are to be located on freehold land that is held by or will be transferred to Council at the time of plan sealing, except that lift stations, and small pumping stations may, with State Government's approval, be located in land that is or will become road reserve. This land shall be provided to Council at no cost as freehold and noted for sewerage purposes;

6.12.1.2 Pumping Stations and lift stations that are not sited beside a road reserve are to be provided with a 5-metre wide access transferred to Council as freehold; and

6.12.1.3 Dedicated or freehold land requirements shall include provision for the pump station offset as indicated in D7.16 Pump Stations.

6.12.2 Pipelines –

6.12.2.1 When pipelines and appurtenances relating to pipelines are constructed in land other than in what is or will become, a dedicated road reserve or property owned by Council, Council requires easements to be registered in its favour for all sewage rising (pressure) mains and all gravity sewers.

6.12.2.2 Easements shall be a minimum of 3m wide and located centrally over the pipeline, where no property boundary is common to any easement boundary. In the case where a pipeline is laid on a standard alignment from a proposed property boundary, the boundary of the lot and one boundary of the easement must be coincident and where the property boundary is to be created in the future, the boundary must be coincident to the easement boundary.

6.12.2.3 Sewers are to be no closer than 1m from an easement boundary except where the sewer is on a preferred alignment; and

6.12.2.4 In the event that works are to be constructed through properties not under the control of the Developer, the Developer shall submit with the Operational Works Application a 'Permit to Enter & Construct' letter, signed by each property owner through whose property the infrastructure is to be constructed, consenting to the construction of the works;

6.12.2.5 Where the property is owned or to be dedicated to Council approval of the relevant section of Council that will manage the property; and

6.12.2.6 Proof of the registration of easements in favour of Council as specified above.

DG 6.13 Property Connections

6.13.1 Property connections shall be installed in accordance with Council's Standard Drawing.

6.13.2 Property connections should generally be located at the lowest corner of the allotment between 0.5 and 1.5m upstream of the allotment boundary or manhole.

6.13.3 Property connections will not be accepted within 0.5m of a lot boundary.

6.13.4 Property connections into manholes will be permitted at ends of line manholes only. Elsewhere, property connections are required "on line" and not into manholes.

6.13.5 Property connections into maintenance shafts require Council approval.

6.13.6 Combined Property Drains are not permitted in any development works.

6.13.7 For commercial / industrial premises, where the PCB is to be built over, a manhole is to be constructed at the point of connection.

6.13.8 Where a sewer main lies within an adjoining allotment, the property connection is to extend a distance of 1.0m into the allotment. For battle-axe allotments with the property connection located within the access, the Property drain shall extend from the property connection along the access to a point 1.0m within the main part of the allotment or, where a sealed driveway is required for the full length of the hatchet 'handle' then 1m past the extents of the driveway to allow a suitable future point of connection. Where a sewer is contained within a stormwater drainage easement, then the property connection should extend a minimum of 1m past the easement boundary and into the lot it is serving. All property connections should be finished a minimum of 1m clear of any infrastructure.

6.13.9 Property connections sizes shall be as follows:

6.13.9.1 Residential (single Dwelling) – 100mm dia; and

6.13.9.2 Others (i.e. Commercial, Industrial, Multi Residential) – 150mm dia.

6.13.10 Property connections to existing sewer mains shall only be permitted when the construction of a new main to service the proposed properties is not possible.

6.13.11 All Property connections shall be deep enough to service the entire lot using the following property drain design criteria:

6.13.11.1 300mm minimum cover at the start of the drain or at any other control point on the allotment, (where property drains are subject to vehicular traffic, cover shall be increased to 600mm);

6.13.11.2 1 in 60 minimum grade from the most distant corner where any Property or structure can be located on the allotment, on an alignment parallel to the property boundary; and

6.13.11.3 Consideration will be given to the finished level of the lot after all earthworks are complete including likely benching for building platforms.

DG 6.14 On-Site Sewerage Facilities – Treatment and Disposal

6.14.1 The Consultant shall submit a report containing a detailed assessment of site and soil factors as per AS1547 2000 Appendix 4.1B. The report shall consider all major constraints and opportunities relating to the management of wastewater in relation to the development. The report must include all site and soil evaluation (SSE) findings and recommendations so that the most appropriate on-site sewerage facility can be chosen for the development and, in particular, be of sufficient quality and size to receive, treat and absorb all wastewater outputs that is likely to be produced on a property. It is not necessary at this stage to indicate a location for the land application area (LAA) but the report must include a site plan for each lot which indicates all unfavourable land due to site restraints, required setbacks and site features thus leaving the final location of the land application area (LAA) flexible until the detailed report is carried out at building stage and final building location is determined.

6.14.2 The minimum requirements for the wastewater disposal report:

6.14.2.1 Site plan showing dams, creeks, bores and water courses over the whole development site;

6.14.2.2 Flood overlay for entire development if applicable (available on Councils website)

6.14.2.3 Contour plan maximum of 1 metre intervals;

6.14.2.4 Areas of each block with proposed Lot No's and property boundaries;

6.14.2.5 Proposed use of the land to be developed;

6.14.2.6 Soil survey, including indicative permeability of soil by either a percolation test or textural classification of soil (minimum of one test site per proposed lot);

6.14.2.7 Depth of ground water, if any encountered during testing;

6.14.2.8 Estimated daily flows of 300 litres per bedroom per day to be utilised in calculations for daily flows;

6.14.2.9 Method of disposal, e.g. Irrigation, ETA, Absorption;

6.14.2.10 Minimum level of treatment of wastewater for each proposed lot;

6.14.2.11 Size of estimated disposal area to suit system;

6.14.2.12 Calculations to justify disposal site; and

6.14.2.13 Assessment of any additional accumulative nutrient loadings of the area caused by onsite waste water disposal from the proposed development.

Pumping Stations and Pressure Mains

DG 6.15 General

6.15.1 Council should be consulted prior to design to determine specific requirements for pumps, electrical, switchboard and telemetry etc. Outlined below are Council's minimum requirements unless specified otherwise.

6.15.2 Council prefers that sewage be conveyed by gravity. Pump station will only be accepted if all other options have been considered and rejected.

6.15.3 Council requires documentary evidence that life cycle costs of all options have been analysed before approving a pumping station.

6.15.4 When the use of a pumping station has been approved it must be designed and constructed in accordance with this Manual and WSA 04-2005 and WRC Standard Drawings.

6.15.5 A submersible sewage pumping station built to Council requirements and incorporating two submersible sewage pumps with motor sizes up to 22 kW each will be regarded as a "standard" installation. Any station with pumps larger than 22kW will be regarded as a "non-standard" installation and will need to be specifically designed to suit the design flows. The design of a "non- standard" station must be carried out in consultation with Council.

6.15.6 Wet well washers are required in all sewage pumping stations unless otherwise approved by council.

DG 6.16 Pump Stations

6.16.1 Pump stations shall be designed as detailed on Standard Drawings S0050 – S-0052 and S-0057 – S-0060. Project specific design drawings are to be provided with the operational works submission which include the following: Relative levels (A through G) as denoted on these drawings as well as all pump start, stop and alarm levels appropriate to operating conditions shall be provided with the pump station design.

6.16.2 Operation levels for pump stations to be controlled by ultra-sonic level controllers or hydrostatic probes and not by float switches. Major pump stations as determined by the Council shall be controlled by ultra-sonic level controllers.

6.16.3 The pump stations overflow pipe shall be designed to cater for the maximum possible flow. Council and the Department of Environment and Heritage Protection should be consulted to determine emergency storage and overflow requirements.

6.16.4 The designer shall be responsible for obtaining all necessary licenses and approvals associated with the provision of pump station emergency overflow.

6.16.5 Pump stations shall be located as far as possible away from existing or proposed habitable dwellings. A 100m setback is desirable with absolute minimum of 30m unless otherwise approved by Council for standard pump stations only. New developments are to comply with the setback conditions from existing pump stations.

6.16.6 The tenure of property on which pump stations and access roads are situated shall be transferred to Council as freehold title. Pump station sites shall not encroach upon gazetted road areas unless otherwise approved by State Government and Council

6.16.7 Access to the pump station site shall be via an appropriate standard sealed 3.5m wide road (within the 5m access reserve) and the pump station site shall accommodate maintenance vehicles and their manoeuvring. An acceptable layout and hard standing area will need to be determined in consultation with council.

6.16.8 The sealed access can be either of the following construction:

6.16.8.1 2 coat seal on 100mm sub-base and 100mm base course, subject to the sub grade strength indicated by the CBR;

6.16.8.2 30mm asphalt on minimum 100mm base course; and

6.16.8.3 125mm thick reinforced concrete.

6.16.9 Pump stations will be located a minimum 300mm above the 1%AEP flood and/or storm event whichever is greater. The finished ground level around the pump station will be shaped to fall away from the pump station. 10. Detailed calculations of the pump station, Sewerage Pump Station Commissioning Plan and pressure main sizing shall be submitted to Council with the design and/or Operational Works submission in the format required by Council.

6.16.10 The Sewerage Pump Station Commissioning Plan shall be completed in accordance with WSA 04- 2005 2.17.

6.16.11 Pump Station switchboards are to be painted with a graffiti resistant paint prior to application.

6.16.12 New or upgraded pump stations which are or will be part of the trunk main reticulation network or have less than 6 hours emergency storage capacity will be required to have a standby generator as part of the sewer scheme. The standby generator will be located a minimum of 300mm's above the 1%AEP flood and/or storm event whichever is greater.

DG 6.17 Sewage Pumping Systems

6.17.1 Sewage Pumping Station Design Criteria - Sewage pumping stations shall be designed in accordance with the minimum specific design criteria shown in Table 7.14 and WSA 04-2005.

Table 7.14 Sewage Pumping Station Design Criteria

Description	Adopted Design Parameter	Comments

Pump Motor Drives	- <15kW – Soft Start - >15 to 22kW – VFD - >22kW – special design – refer to Council	Where VFD's are used, cables are to be shielded. Where VFD's are used, a magnetic flow meter must be provided with the pump station.
Number of Pumps	Two (2)	Pump station controls must allow for automatic alternating duty pumps.
Wet Well Operating Volume (kL) - Fixed Speed Pumps	$\frac{0.9 \times Q}{N}$	Where 'Q' is the flow rate (l/s) if a single pump operating and 'N' is the allowable number of pump starts, the number of pump starts (N) should be not more than 10 for pumps less than 50kW rating. For pumps greater than 50kW rating, according to manufactures recommendations
Wet Well Operating Volume (kL) – Variable Speed Pumps	$\frac{0.9 \times Q}{N}$	Q = Discharge of a single pump (L/s) at 50 Hz. N = Maximum number of starts per hour recommendation by the motor manufacturer.
Bottom Water Level (duty pump cutout)	- For fixed speed pumps: 100mm above minimum submergence level of pumps. - For variable speed pumps: minimum of 100mm above top of motor casing.	In case of variable speed drives a permanent water level must be maintained above the motor casing to ensure continuous cooling of the motor.
Well Diameter	Minimum internal well diameter 2100mm internal well diameter may be increased in increments of 300mm depending upon considerations such as: - Clearance around pumps and pipework; - Depth of pump station; and - Geotechnical conditions.	
Top Water Level (TWL) (standby start)	Must be set no higher than 300mm below invert level of inlet sewer. Must be no lower than 100mm above duty start but confirmed by project specific design.	
Operating Range (TWL – BWL)	This shall be in accordance with WSA 04, Clause 5.4. Generally this	

	range should be between 1000mm and 2800mm.	
Duty Point	With static head corresponding to top water level and pipe friction factors as follows determine Duty Point 1 and 2: - Duty Point 1 – Single Pump operation: - C1 x ADWF (L/s) vs. Static Head = Friction Head (m) - Duty Point 2 – Duty Pump operating in parallel with Standby Pump: - 5 x ADWF (L/s) vs. Static Head + Friction Head (m).	Where: Static Head = Highest Point in Pressure (Rising) Main – Water Level in Wet Well. Friction Head = is a derived from the Hazen Williams formula. C1 = Peaking Factor from Table 7.2 of this Manual.
Pump Selection	Select a pump that is capable of operating at both duty points and which operates within the range of the system resistance curves that are determined by the Conditions detailed below: - Where pressure sewers are allowed to interconnect with existing sewers (refer Table 7.15), pumps are to be designed to operate against the ultimate pressure in the receiving main unless otherwise approved by Council; - Condition 1 – Normal Operating Condition lower limit system resistance curve: - Static Head corresponding to Top Water Level with pressure (rising) main friction factors as follows: C = 120 (dia. 300mm) - Condition 2 – Normal Operating Condition Upper limit system resistance curve: - Static Head corresponding to Bottom Water Level with pressure (rising) main friction factors as follows: C = 100 (dia. <300mm)	The friction factors used in pump selection depend on Top and Bottom Water Level so as to ensure the fullest possible range of heads are taken into account in the selection of the pumps.
Emergency Storage	6 hours ADWF	May vary dependent on location of the overflow. Emergency storage may

		include gravity sewers, manholes and pump station we well volume above TWL.
Duty Pump Capacity	Refer DNRM Guidelines (or subsequent department)	Refer DNRM Guidelines (or subsequent department)
Standby Pump Capacity	Refer DNRM Guidelines (or subsequent department)	Refer DNRM Guidelines (or subsequent department)
Total Pump Station Capacity	Refer DERM Guidelines (or subsequent department)	Refer DERM Guidelines (or subsequent department)

6.17.2 Pump Information - The following information shall be provided when the plans are submitted for approval:
- 6.17.2.1 Preliminary pump selection;
- 6.17.2.2 Rating of the motor;
- 6.17.2.3 Weight of the motor;
- 6.17.2.4 Duty Point;
- 6.17.2.5 Estimate of KWh/1000 litres pumped; and
- 6.17.2.6 Performance, power and efficiency curve.

DG 6.18 Pressure Mains

6.18.1 For detailed design of sewer pressure mains (rising mains) the requirements of Design Manual D6 Water Reticulation should be noted and the mains shall be designed as per the procedures relevant to Water Supply Mains with the exception of the following:
- 6.18.1.1 Air release valving should be provided to high points as required;
- 6.18.1.2 Scour valving should be provided to low points as required. Scouring must be to a scour manhole or adjacent gravity sewer system;
- 6.18.1.3 Thrust Block and Trenching Details shall be as per the Standard Drawings W-0040 and W-0041; and
- 6.18.1.4 Line valves, scours and air valves are to be provided as required to reduce scour volume.

6.18.2 Consideration needs to be given to the potential for sulphide generation in pressure mains.

6.18.3 Sewer rising mains shall be a minimum 125mm DN HDPE PN16 unless approved otherwise by Council. Sewer rising mains shall be ‘cream’ in colour.

6.18.4 Sewer pressure mains shall be ‘cream’ in colour.

6.18.5 All Discharge manholes shall be fitted with a HDPE or wound PVC manhole liner suitable for exposure to sewerage. Where the discharge manhole is an existing manhole, the manhole internal surfaces shall be adequately dried and then coated with an approved epoxy coating.

6.18.6 Sewer pressure mains shall be designed in accordance with the minimum specific design criteria shown in Table 7.15 and WSA 04- 2005.

Table 7.15 Pressure Main Design

Description	Adopted Design Parameter	Comments
Flow equation	Hazen-Williams	
Minimum Diameter	100mm – unless otherwise approved by Council	
Friction Factors	Refer Item 10 in Table 7.14	
Minimum Velocity (on a daily basis)	0.75m/s	To prevent the deposit of solid materials such as grit
Preferred Minimum Velocity (on a daily basis)	1.5m/s	To provide for slime stripping on a regular basis
Maximum Velocity	2.5m/s	To prevent damage to pipe lining
Configuration	Pressure Mains should be sized to optimise the balance between reduction of detention times and life cycle cost. Factors to be considered include but not be limited to: - Population growth; - Staging; - Operational features to provide for maintenance and replacement activities; - Minimisation of energy costs; and - Detention times (reduction of odours)	
Interconnection of Pressure (rising) Mains from different Pump Stations	Only with the approval of Council. Generally interconnection of pressure (rising) mains from different pump stations will not be approved unless there are substantial economic and operational benefits	Selection of the class of mains shall be for the maximum condition, refer pump selection, Table 7.14

Private Pump Station and Pressure Mains

DG 6.19 General

6.19.1 Sewage pumping stations serving more than one “Titled” property shall meet the requirements of this Manual and WSA 04–2005.

6.19.2 Where a gravity sewer connection is not directly available to a development, Council may approve a private sewage pumping station, which will discharge via a private pressure (rising main) to the property line, after which, it shall be a Council main, and then connected to Council’s reticulation infrastructure. The

Developer shall prepare and provide to Council "As Constructed" drawings. A private pressure main is not acceptable within a Council controlled road reserve.

6.19.3 All costs associated with connection of a private pressure main to an existing gravity sewer system (system analysis, design and upgrades to provide capacity) shall be met by the Developer.

DG 6.20 Connection to Existing Gravity Main

6.20.1 The approved connection point for a private pressure (rising) main shall be a discharge manhole that is connected to an existing gravity sewer manhole. Discharge manholes shall conform to Council's Standard Drawing.

6.20.2 Council may require the provision of a non-corrosive pipe installed for the length of sewer to the next downstream manhole and will require the provision of an inert lining to all internal surfaces of the pressure main discharge manhole.

DG 6.21 Alternative Connection Points

6.21.1 Council may consider an alternative connection point. Where an alternative is proposed, the Consultant shall request written approval from Council. The request shall outline the reasons for the alternative connection point and the connection methodology proposed.

6.21.2 A private pressure main is not permitted to inject into another private pressure main.

6.21.3 If Council approves the alternative connection to be a Council rising main, the conditions outlined in Table 7.15 shall apply.

DG 6.22 Private Pump Station Sizing and Operation

6.22.1 Pumping stations shall be designed with sufficient in-system storage (in the well, upstream sewers or a dedicated self-draining high level storage) so that in the event of pump or power failure, 6 hours' emergency storage is provided with inflow at average dry weather flow, provided the scheme is not a low pressure sewer scheme or vacuum system. In system storage shall be measured from duty start level to the level of the lowest relief point. Low pressure sewer or vacuum schemes shall be looked at separately by Council.

6.22.2 Less than 6 hours of storage may be provided, as long as a standby generator is part of the sewer scheme.

6.22.3 The pumps are to be set up to operate automatically as Duty / Standby and should be of the positive displacement electric type.

6.22.4 An alarm shall be provided in the form of a prominently positioned flashing red light set to activate at the invert level of the incoming Property drain.

DG 6.23 Private Pressure Mains

6.23.1 Medium density polyethylene pressure main class PN16 is approved for use with cream colouring.

6.23.2 If the pressure main is not readily available in cream colour, the pressure main shall be wrapped in cream coloured tape.

DG 6.24 Specific Requirements

6.24.1 As the private sewage pumping station is a component of the internal plumbing and drainage, Council's Plumbing and Drainage Services Section shall check the design drawings for compliance with current legislation and relevant standards.

6.24.2 Owners of private pumping stations are responsible for all costs and charges associated with the installation, operation and maintenance. Council may consider entering into a service agreement with the owner of the pump station for the ongoing operation and maintenance of the pump station.

6.24.3 As constructed details and the location of the pressure main shall be submitted to Council.

6.24.4 Where Council accepts a Maintenance Service Agreement with the owner of a private pump station, the following conditions will apply:

6.24.4.1 The pump station control panel should incorporate SCADA equipment for transmission of monitoring data and control of Council's existing master system;

6.24.4.2 Council requirements for integrating the SCADA equipment will not relieve the owner of the responsibility for the operation and maintenance of the pump station during the agreed defect liability period;

6.24.4.3 Council will not accept responsibility under the Service Agreement until the pump station has been accepted "off maintenance" with all defects rectified and the pump station is operating to the satisfaction of Council;

6.24.4.4 Notwithstanding the above, Council may monitor the operation and performance of the pump station during the defects liability period; and

6.24.4.5 The following information shall be provided when the plans are submitted for approval:

6.24.4.5.1 Place of Manufacture of all components;

6.24.4.5.2 Pump Manufacturer, Model, Type, and Impeller diameter (as a cut sheet)

6.24.4.5.3 Rating of the motor;
6.24.4.5.4 Weight of the pump and motor;
6.24.4.5.5 Duty Points;
6.24.4.5.6 KWh/1000 litres pumped;
6.24.4.5.7 Performance curves; and
6.24.4.5.8 Guarantee.

6.24.5 Upon commissioning, the following information shall be provided to the Council for checking prior to survey plans being endorsed by Council:
6.24.5.1 Curves with at least four points plotted of the actual performance established in the field, or similar supervised works certificate;
6.24.5.2 Actual KWh/1000 litres pumped;
6.24.5.3 Complete wiring diagrams and details;
6.24.5.4 Mechanical details and parts list of pump and motor;
6.24.5.5 Maintenance catalogue showing daily, weekly, monthly and annual requirements;
6.24.5.6 A complete set of the manufacturers recommended spares delivered to Council; and
6.24.5.7 A set of cover lifters delivered to Council.

Telemetry Systems and Management Plan

DG 6.25 Telemetry Systems

6.25.1 All pump stations must be fitted with telemetry system in accordance with Council's Specification for Telemetry Systems. Council should be contacted to obtain a copy of their Technical Specification for Telemetry Systems.
6.25.2 It should be noted that where amalgamated Councils have varying telemetry systems, left over from pre-amalgamation Councils, pump station telemetry systems and requirements may vary within that Council and requirements must therefore be reconfirmed as a part of the design.

DG 6.26 Management Plan

6.26.1 Where required, a facility management plan is to be provided which will detail procedures and arrangements in place for routine operation and management of the facility (eg. Service Agreement) The Facility Management Plan shall include:
6.26.1.1 Details of proposed regular maintenance of private sewer systems; and
6.26.1.2 A bi-annual report of sewerage flows to Council's sewer and details of maintenance activities.

DG 7 – DESIGN GUIDELINES – Maintenance Shafts

DG 7.1 General

7.1.1 The use of maintenance shafts is permitted in reticulation sewers subject to the design parameters detailed in this Manual and WSA 02-2014.

DG 7.2 Design Parameters for MS's and TMS's

7.2.1 The following design parameters apply to maintenance shafts and terminal maintenance shafts in addition to or instead of those detailed in WSA 02-2002:

- 7.2.1.1 Sizing and installation of maintenance shafts to generally comply with the manufacturers recommendations;
- 7.2.1.2 Maintenance shafts shall be graded to the intersection point of the sewer main and maintenance shaft coupling / fitting;
- 7.2.1.3 Maintenance shafts may be used on 100mm, 150mm and 225mm diameter sewer mains and Property connection branches only;
- 7.2.1.4 Maintenance shafts shall be used to a maximum depth of 3.0m;
- 7.2.1.5 Testing of maintenance shafts shall generally be carried out in conjunction with the testing of the sewer main;
- 7.2.1.6 Property connection branch inspection tees shall be 2000mm clear of the centre of the Maintenance Shaft;
- 7.2.1.7 Property connections must not be made into maintenance shafts;
- 7.2.1.8 Maintenance shafts must be provided with a Council approved 600mm dia. Ductile Iron Class B cover located within a precast surround. The trench bedding material shall extend below the shaft inspection opening surround;
- 7.2.1.9 A maximum of five (5) Maintenance Shafts will be permitted between two conventional maintenance holes with a total length of sewer of not more than 300m between maintenance holes;
- 7.2.1.10 Maintenance Shafts are to be located with a maximum spacing of 60 metres to a maintenance hole or shaft;
- 7.2.1.11 The combined flow entering a MS will not exceed 22 L/s;
- 7.2.1.12 The flow to be redirected at an angle greater than 45 degrees will not exceed 12 L/s; and
- 7.2.1.13 The vertical distance a sewer connection entering the riser and the invert of a MS will be a minimum of 1100mm. Where this distance is less then 1100mm the incoming sewer will enter at the invert of the MS.

7.2.2 Maintenance shafts and terminal maintenance shafts are not permitted in the following locations:

- 7.2.2.1 As the receiving manhole at a pumping / lift station;
- 7.2.2.2 As a discharge manhole for a pressure (rising) main;

7.2.2.3 Within roadway central medians, roundabouts or within kerb and channel;
7.2.2.4 As the connection structure for future development stages; and
7.2.2.5 In an area zoned Industrial, Commercial, or Multi-unit.

DG 8 – DESIGN GUIDELINES – Water Seals, Boundary Traps and Water-sealed MH's and Gas Check MH's

DG 8.1 General

8.1.1 Water seals - Water seals are not required.
8.1.2 Gas Check MH's - Gas check MH's are not required.
8.1.3 Vertical and Near Vertical Sewers - Prior approval must be obtained from Council for the use of vertical or near vertical sewers.
8.1.4 Vortex Inlets and Water Cushions - Prior approval must be obtained from Council for the use of water inlets and water cushions.
8.1.5 Inverted Syphons – The use of inverted syphons is not permitted.
8.1.6 Flow measuring devices – flow measuring devices are not required to be installed. Notwithstanding, provision shall be made in the design of the valve chamber to allow the future installation of an electromagnetic flow meter.
8.1.7 Wet weather storage - Prior approval must be obtained from Council for using wet weather storage as a means of reducing downstream infrastructure.

DG 9 – DESIGN GUIDELINES – Utilities

General

DG 9.1 Scope

9.1.1 This section sets out the minimum standards for the provision of utility services within new subdivisions and developments.

9.1.2 The designer needs to coordinate the provision of services within the confines of the road verge in consultation with and to the requirements of the Service Authorities / Providers.

DG 9.2 Objective

9.2.1 The objective of the Manual is to assist the designer in making provision for the following utility services within the design of new subdivisions and developments:

- 9.2.1.1 Telecommunications;
- 9.2.1.2 Electricity Supply;
- 9.2.1.3 Road Lighting; and
- 9.2.1.4 Gas.

DG 9.3 Reference Documents

9.3.1 AS/NZS 1158-2010 Lighting for Roads and Public Spaces

9.3.2 Ergon Energy Standard Drawings

- 9.3.2.1 Standard Drawing 5162/1 - Joint Electricity, Gas and Telecommunications; and
- 9.3.2.2 Standard Drawing 5162/2 - Joint Electricity, Gas and Multiple Telecommunications.

9.3.3 Civil Aviation Safety Authority Australia – Manual of Standards Part 139 Aerodromes;

9.3.4 Ergon Energy Lighting Construction Manual;

9.3.5 Ergon Energy Underground Construction Manual

9.3.6 G645:2011 Fibre Ready Pit and Pipe Specification for Real Estate Development Projects / NBN Co Installing Pit and Conduit Infrastructure – Guidelines for Developers

DG 9.4 Service Authority's General Requirements

9.4.1 Prior to an application to reconfigure a lot, the Service Authorities should be consulted to confirm that the provision of services to the proposed development would be provided. E.g. Telstra, Ergon and NBN Co.

9.4.2 Following receipt of Development Approval from Council the designer shall make application to both Authorities for "Offer of Connection Services" for electricity and telecommunication services.

9.4.3 Approved proposal plans shall be supplied to both Authorities, for staged developments, this shall include an overall concept layout outlining stages and expected timing for each stage.

9.4.4 Should any amendment occur in the design, both Authorities are to be notified immediately together with an amended plan.

9.4.5 Where a development includes lots that may have higher service demands (i.e. Industrial, Commercial, Multi Residential etc.), details of the expected yields and the maximum permissible development yield for each lot in accordance with its current zoning shall also be provided to both Authorities.

9.4.6 Underground telecommunication services shall be provided to all new developments.

9.4.7 Unless otherwise approved by Council, an underground electricity supply is to be provided to all new developments and all new consumer mains connections to developments to be supplied from a pillar.

9.4.8 The designer shall be responsible for coordinating and checking the locations of all telecommunication and electrical services to avoid conflicts with other services (i.e. Stormwater pits etc).

9.4.9 Layout plans for telecommunication and electrical services including the road lighting design shall be submitted to Council with the design submission.

9.4.10 Evidence of the agreement to provide an electricity supply and telecommunication services must be given to Council prior to the sealing of plans of survey.

DG 9.5 Telecommunication Services

9.5.1 Installing of underground telecommunication conduits shall be in accordance with the Service Authority's requirements.

9.5.2 Consideration shall be given to the location of any roadside cabinets, pillars and pits within the subdivision design.

9.5.3 Where an underground telecommunication service is to be provided, telecommunication conduits shall be placed in a shared trenching arrangement, refer Ergon Energy Standard Drawings 5162/1 and 5162/2 for shared trench arrangement that incorporates telecommunication, electrical and gas services.

9.5.4 Unless approved otherwise by Council, all telecommunication services shall be located within the road reserve at a distance of 0.3m – 1.2m from the property boundary.

9.5.5 The developer is responsible for the provision of telecommunication conduits across roads, existing roads are to be bored.

9.5.6 Permanent non-ferrous cable markers are to be installed in the kerb to mark the location of all road crossings.

DG 9.6 Electricity Supply

9.6.1 Unless otherwise approved by Council, electricity reticulation is to be placed underground.

9.6.2 Where an underground electrical service is to be provided it shall be placed in a shared trench arrangement. Refer relevant Ergon Energy Standard Drawings for shared trenching arrangements that incorporates telecommunication, electrical and gas services.

9.6.3 Sharing of trenches with sewerage and water mains shall not be permitted. Where existing or proposed services are likely to impede on standard electricity alignments, Council and the Ergon Energy are to be consulted to confirm service alignments and clearances.

9.6.4 Unless approved otherwise by Council, all electrical services shall be located within the road reserve at a distance of 0.3m – 1.2m from the property boundary.

9.6.5 The developer is to liaise with the Ergon Energy in relation to any requirement for an electrical substation with a view to providing sufficient suitable land on which to site the infrastructure.

9.6.6 Where a pad-mount substation is to be located within the frontage of a proposed or existing parkland, the location shall be subject to Council's approval.

9.6.7 No other services shall pass beneath the Ergon Energy pillars or substations.

9.6.8 The developer is responsible for the provision of electrical conduits across roads, existing roads are to be bored.

9.6.9 Permanent non-ferrous cable markers are to be installed in the kerb to mark the location of all road crossings.

9.6.10 Electrical pillars shall generally be located at an alternate boundary to water meters and gas service crossings. Exceptions may be considered in individual circumstances were unusual conditions or lot layouts exist and where approved by Council and the Ergon Energy.

9.6.11 Pillars shall be located at property boundaries exceptions can occur where there are stormwater easements or other constraints. The Ergon Energy should be consulted to determine alternate locations in these cases.

9.6.12 The Ergon Energy conditions of connection including contributions for initial cable installation works shall be met prior to the acceptance of the works "On Maintenance" by Council.

9.6.13 Where advised by the Ergon Energy an additional communication conduit supplied by the service provider shall be laid to Ergon Energy requirements.

Overhead Supply

DG 9.7 General

9.7.1 The overhead electrical reticulation shall be designed in accordance with the Ergon Energy requirements.

9.7.2 Power poles shall be placed on an appropriate alignment as approved by Council and the Ergon Energy.

DG 9.8 Road Lighting

9.8.1 All road lighting designs shall be prepared by an RPEQ Engineer shall be included in the design submission for acceptance by Council.

9.8.2 Road lighting design must be in accordance with this manual and AS/NZS 1158 and the Ergon Energy Lighting Construction Manual and Underground Construction Manual. Specific consideration must be given to identification and lighting of Local Area Traffic Management devices (LATM's) and intersections.

9.8.3 All light columns, luminaries and lamps are to be specified from the Ergon Energy Lighting Construction Manual and Underground Construction Manual.

9.8.4 All installation works shall be in accordance with the Ergon Energy Lighting Construction Manual.

9.8.5 Lighting on declared roads shall be designed and installed to the requirements of the Department of Transport and Main Roads.

9.8.6 It is a Council requirement that road lighting be installed under Rate 2 conditions of Tariff 71 - Public Lamps at all new subdivisions and developments.

9.8.7 The required lighting category for a particular road hierarchy shall be determined from Table D9.1.

Table 9.1 Lighting Categories

Category	Application[1]	Luminaire Type	Lamp Type	Rate[2]
V3	Sub Arterial Road	Aeroscreen	150 – 400 watt HPS	2
V5	Major Collector Road	Aeroscreen	150 – 400 watt HPS	2
P3	Minor Collector Road	Normal	80 Watt MV[4]	2
P4	Residential Street Access Street	Normal[3]	50 Watt MV[4]	2

	Access Place			
P4	Industrial Collector Street Industrial Access Street	Normal	80 Watt MV[4]	2
P1 – P3	Pathway and Cycleway	Normal[5] OR Council Specific	80 Watt MV Council Specified	2 3
P3	Bus Stop	Aeroscreen OR Normal	Wattage as required HPS – Cat V lighting MV – Cat P Lighting	2

1. **Roadway Classifications are contained in Table D1.1 "Street and Road Hierarchy – Deemed to Comply Requirements" of Design Manual "D1 Road Geometry". Where discrepancies exist between No. of Dwellings, Traffic Generation and Roadway Classification, lighting design shall be based on the Council designated Roadway**
2. **Rate 2 – Lighting owned and maintained by the Ergon Energy. Rate 3 – Lighting owned and maintained by Council.**
3. **Where "Nostalgia" luminaires are used, the lamp type is to be an 80 Watt MV. The "Nostalgia" luminaire must meet the glare control requirement stipulated in AS/NZS 1158.3.1:2005, design is to be based on "I" table 201262.CIE and the luminaire sourced directly from Sylvania.**
4. **Once permitted by the Electricity Authority, T5 fluorescent or compact fluorescent lamps shall be used where they offer a lower energy consumption or lower cost solution than the lamps nominated.**
5. **Where lighting is located next to residences (on a pathway or cycleway) then a Type 4 – Aeroscreen luminaire is required.**
6. **In general, street lighting poles are to be located opposite common allotment boundaries, to minimise potential interference with vehicle access, access to services (i.e. hydrants) and glare complaints from residents. It is desirable that poles not be located opposite boundaries of "battle axe" allotments due to a higher potential for vehicle collision.**
7. **Council may consider a lesser standard for subdivisions with lots greater than 4000m2 and outside the designated urban footprint. e.g. Category P5 or lighting at intersections, cul-de-sac's and other hazardous locations.**

9.8.8 Lighting shall be provided at the following locations in accordance with the development approval conditions and AS/NZS 1158:

9.8.8.1 Straight Sections;

9.8.8.2 Curves;

9.8.8.3 Intersections and Junctions;
9.8.8.4 Pedestrian Refuges;
9.8.8.5 Cul-de-sacs; and
9.8.8.6 Local Area Traffic Management Devices including Roundabouts. (The maintained horizontal illuminance is not to be less than 3.5 lux).

9.8.9 Where a pedestrian crossing has been installed it shall be lit in accordance with AS 1158.4 – 2009, Lighting of Pedestrian Crossings.

9.8.10 Lighting of entry points to pathways and cycleways shall be achieved by the selected placement of a road light nearby.

9.8.11 Additional lighting shall be provided at a designated bus stop facility; the design shall include the entry and exit lengths of the bus stop.

9.8.12 Lighting columns are to be offset a minimum of 820mm (+/- 20mm) from the invert of kerb and channel to centre of the pole. For a road with a flush kerb or a low density residential road that has a table drain instead of layback kerb and channel, the lighting column is to be offset 1300mm (+/- 20mm) from the outer edge of traffic lane to centre of the pole.

9.8.13 Where required to clear conflicts e.g. stormwater, sub-soil drain flushing points, water supply infrastructure, sewerage infrastructure, lighting columns can be located up to 0.5m in either direction from boundary prolongation along the roadway and at an alignment up to 1.1m from the invert of the kerb and channel.

9.8.14 The placement of lighting columns shall not occur within 1m of any water main that crosses the road.

9.8.15 Lighting columns that are to be installed at all new subdivisions and developments are to be a four hole base plate mounted steel pole as specified in the Ergon Energy Lighting Construction Manual.

9.8.16 When joining to an existing installation or extending a subdivision in stages, lighting columns and luminaires shall match as near as possible with the existing infrastructure.

9.8.17 The use of aeroscreen luminaires may be required when road lighting is installed near airports, refer to the Civil Aviation Safety Authority Australia – Manual of Standards Part 139.

9.8.18 Documentation shall be submitted to Council with the design submission demonstrating compliance with the AS/NZS 1158.

9.8.19 Foundation footing for minor road lighting must be cast in situ, a precast concrete foundation is not permitted without prior approval of council.

9.8.20 Existing timber street light poles are to be replaced with a steel lighting column when overhead powerlines are augmented underground.

DG 9.9 Park Lighting

9.9.1 Lighting requirements in parks will be advised by Council in accordance with the classification of the park.

9.9.2 A point of supply is required to all parks location will be advised by Council in consultation with Ergon Energy

9.9.3 Pathways or cycle ways within parks that require lighting shall be lit to the minimum lighting category P3 or above as deemed appropriate from the selection criteria tabled in AS/NZS 1158.

DG 9.10 Gas

9.10.1 Gas reticulation within a new subdivision or development may be installed subject to Council's approval.

9.10.2 Where reticulated gas is approved by Council, the gas service shall be located in the shared trench arrangement. Refer Ergon Energy Standard Drawings 5162/1 and 5162/2 for shared trenching arrangements that incorporates telecommunications, electrical and gas services.

9.10.3 The location of a central storage facility shall be on a separate freehold parcel of land with appropriate security to the satisfaction of the Council.

9.10.4 The Developer shall be responsible for obtaining all relevant approvals and licences necessary for installation.

DG 10 – DESIGN GUIDELINES – Landscaping

General

DG 10.1 Scope

10.1.1 This section sets out the minimum standards for landscaping within new subdivisions and on-street works for private developments.

10.1.2 This manual contains procedures for the design of:

- 10.1.2.1 On-street landscaping works, including buffers mounds, traffic islands and roundabouts; and
- 10.1.2.2 Public Open Spaces including, signage, furniture and playgrounds.

DG 10.2 Objective

10.2.1 The objective of this manual is to define Councils minimum landscaping requirements and to assist the designer in achieving the following:

- 10.2.1.1 Visually enhancement of the streetscapes;
- 10.2.1.2 Enlargement of the habitat and plant diversity in order to provide a food source for indigenous fauna;
- 10.2.1.3 Enhanced living environments by reducing the impacts of noise, fumes and car headlights;

10.2.1.4 Provision of shade trees; and
10.2.1.5 Crime prevention through environmental design (CPTED).

DG 10.3 Reference Documents

10.3.1 Whitsunday Regional Council:
10.3.1.1 Planning Scheme – Landscaping Code;
10.3.1.2 Local Laws and Policies;
10.3.1.3 Levels of Service/Operations Plan – Parks & Gardens
10.3.2 Australian Standards:
10.3.2.1 AS/NZS 1158.3-2005 Pedestrian area (Category P) lighting
10.3.2.2 AS 3500 National Plumbing and Drainage, Part 1.2 Water Supply – Acceptable Solutions
10.3.2.3 AS/NZS 4486 Playgrounds and playground equipment - Development, installation, inspection, maintenance and operation.
10.3.3 Wet Tropics Weed Pocket Guide

DG 10.4 General

10.4.1 At the time of development, the developer shall provide all on-street landscaping, this shall include street tree planting, grass establishment to road verges, and landscaping of traffic islands and buffer mounds.
10.4.2 Council should be consulted prior to commencement of the design to ascertain whether there are any site specific design requirements.
10.4.3 Some Local Authorities have plant selection guidelines and suburban planting themes designers are encouraged to consult with Council in the preparation of the landscaping design.
10.4.4 Landscaping plans shall be prepared by a person of professional standing in the field of Landscape architecture or landscape design, at a standard acceptable to Council.
10.4.5 CCA treated timber is not to be used for the construction of Council assets.
10.4.6 ACQ, Copper Azole, LOSP, or another alternative timber treatment, will be considered for approval by Council, so long as each individual piece of timber is clearly marked to show the treatment type, e.g. 'ACQ, Copper Azole, LOSP' or other similar text as appropriate. In some instances, (e.g. high use public areas), Council will require these markings to be burn branded into exposed timber areas also. In this regard reference should also be made to Council specific standard drawings for additional marking of treated timber elements that are used in the construction of Council assets in high use public areas.

DG 10.5 Existing Vegetation

10.5.1 In order to retain any established landscape character, all trees located within existing road reserves shall be protected and retained unless approved otherwise by Council.

10.5.2 Significant trees located within the verge of new road reserves shall be protected wherever possible and where advised by Council. This may require the adoption of non-standard utility service alignments therefore designers are encouraged to discuss proposed solutions with Council.

DG 10.6 Verges

10.6.1 All verges shall be covered full width with topsoil to a depth of not less than 50mm and shall be lightly compacted and grassed in accordance with Councils minimum standards and Specifications.

10.6.2 In order to guarantee a high standard of maintenance all verges are to be in a mowable condition, free from rocks and loose stones, and graded to even-running contours.

10.6.3 Aside from grass establishment and tree planting, landscaping of the verge between the property boundary and kerb is not a Council requirement. However, additional landscaping within the verge may be considered subject to Council approval. Generally, any additional landscaping shall be clear of underground services or alternatively limited to ground covers or small shrubs less than in 500mm height.

10.6.4 Should any excavation of the underground services in this vicinity of the additional verge landscaping be required, thus destroying the vegetation, Council will not be held responsible for plant replacement. Maintenance of planting in this vicinity will be the sole responsibility of the adjacent property owner/occupier.

DG 10.7 Street Tree Planting

10.7.1 The ultimate aim of street tree planting is to provide:

10.7.1.1 An attractive streetscape with character and charm. An individual character may be obtained by using a specific tree species for each street;

10.7.1.2 Shade, and the reduction of heat and glare from the road pavement. Parked cars may remain cool during the summer months; and

10.7.1.3 Habitat provision and enhancement. Native flowering trees provide a source of food and shelter for insects, birds and animals.

10.7.2 An avenue of trees of identical species and size planted at regular intervals has far greater visual and aesthetic impact than a mis-matched selection of

incompatible trees. In order to promote continuity in new streetscapes, a single species should be nominated for each street.

10.7.3 Where a development is occurring in an established street setting, an assessment of the existing trees should be made, and the most prevalent and healthy species chosen for verge planting.

10.7.4 Tree species shall be selected for their suitability to the site conditions (e.g. small trees under power lines, drought resistance, soil suitability) and shall be in accordance with any relevant Council plant selection guidelines and suburban planting themes.

10.7.5 To ensure consistency in growth rate and form all trees shall be no less than two (2) metres in height and shall be well established in their root and branch formation. A minimum 45 litre container should ensure a good survival factor.

10.7.6 The alignment and placement of street trees measured from the tree at the estimated ultimate size shall be in accordance with the following:

- 10.7.6.1 Greater than 4.0 metres from electricity or telecommunication poles or pillars;
- 10.7.6.2 Greater than 7.5 metres from streetlights to ensure effective street lighting;
- 10.7.6.3 Greater than 4.0 metre radius from high voltage transmission lines;
- 10.7.6.4 Greater than 2.0 metres from stormwater drainage pits;
- 10.7.6.5 Trees are to be planted in the front of properties at the centre of the lot at a rate of one per lot, or at the necessary rate to provide a maximum 20 metre spacing;
- 10.7.6.6 Trees are to be placed a minimum 1000mm from the back of kerb where achievable;
- 10.7.6.7 Trees are to be placed a minimum of three (3) metres from driveway;
- 10.7.6.8 At intersections trees are to be placed a minimum of ten (10) metres back from the face of the kerb of the adjoining street;
- 10.7.6.9 Trees are to be located so as not to obstruct access to any services or signage; and □Trees are to be located so as not to obstruct pedestrian or vehicular traffic, nor create traffic hazard or cause damage to existing trees.

10.7.7 Street trees shall be planted in accordance with Standard Drawings SEQ G-010 – SEQ G-012 and installed in accordance with Council Specifications.

10.7.8 Street trees should not be a plant listed in:

- 10.7.8.1 Land Protection (Pest and Stock Route Management) Regulation;
- 10.7.8.2 Pest Management Plan; or
- 10.7.8.3 Wet Tropics Management Authority Publication Agricultural and Environmental Weeds.

DG 10.8 Buffer Zones

10.8.1 Mounds / Buffers adjacent to major roads controlled by the Department of Main Roads must comply with the requirements as specified by the Department of

Main Roads and as detailed herein. Generally, these buffers are ten (10) metres wide along the full frontage of the major road.

10.8.2 The aim of the Buffer Mound landscaping is to: ☐Reduce the visual impact of adjacent development by screening rooflines; ☐Reduce the visual impact of proposed noise attenuation barriers, which may be constructed at some time in the future on the mound crest; ☐Reduce the visual impact of the mound's severe geometric landform by screening with foliage to ground level; ☐ Introduce a "natural" vegetated landscape appearance by replacing open agricultural land with a facade of dense planting; ☐Reinforce the local character by indigenous tree and shrub species; and ☐Provide additional functions, i.e.. shade over adjacent bikeways.

10.8.3 In order to accomplish the above aims, the species mix of plant selection should incorporate a range of species to provide variation in form, colour and texture, to contribute to a natural appearance. The front line of planting should have foliage down to ground level.

10.8.4 To ensure that buffer mounds are given the best possible chance of successful establishment and prolonged survival, a temporary irrigation system is required to be installed to the mounding. The preferred system is with a drip-style irrigation system or similar below the surface of the mulch, which reduces the chances of vandalism and reduces excess water loss as a result of runoff and evaporation.

10.8.5 Strong recognisable character is further reinforced by repetition of some suitable species as street and park trees in the adjacent subdivision

10.8.6 Use of disciplined plant selection based on themes such as colour, texture, or natural species associations, in addition to site suitability, creates higher quality landscapes than random assortments of nursery stock chosen solely for short notice availability and growth suitability.

10.8.7 Advance ordering and growing on contracts are desirable to ensure availability of desired species in the large quantities required.

10.8.8 Local rainforest species, which typify and reinforce the regions image, are preferred. Most are hardy, long-lived and have dense growth, which suppress weeds and reduce long-term maintenance.

10.8.9 The landscaping shall be designed so as not to create a safety risk to people using the mound and adjacent areas (i.e. no thorns, heavy nuts or poisonous fruits or berries).

10.8.10 No tree planting shall be done higher than 1/3 from the base of mound i.e. no trees on top of the mound.

Public Open Space

DG 10.9 General

10.9.1 At the time of development, the developer shall landscape all public open spaces to the satisfaction of Council and in accordance with this manual and Council's Levels of Service/Operations Plan.

10.9.2 Where a development is proposing to undertake any work within existing or proposed park a landscaping plan shall be prepared for consideration by Council.

10.9.3 Developers should have regard to Table 10.1 – Guidelines for Embellishment.

Table 10.1 – Guidelines for Embellishment

		Guidelines for Embellishment													
Classification	**Profile**	**Playground**	**BBQ's**	**Shelters**	**Amenities**	**Structures**	**Irrigation**	**Mulched Beds**	**Manicured Lawns**	**Grassed Areas**	**Dog Park Areas**	**Exercise Equipment**	**Shade Trees**	**Park Furniture**	**Sporting Equipment**
Regional (Recreational)	High	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
District/ Cemetery (Recreational)	High	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	
Local (Recreational))	Medium							✓		✓			✓	✓	
Local (Recreational)	Low									✓			✓		
District & Regional Sports Park	High	✓		✓	✓	✓	✓			✓			✓	✓	✓

10.9.4 Landscaping plans shall be prepared by a person of professional standing in the field of landscape architecture or landscape design, at a standard acceptable to Council.

10.9.5 CCA treated timber is not to be used for the construction of Council assets.

10.9.6 ACQ, Copper Azole, LOSP, or another alternative timber treatment will be considered for approval by Council, so long as each individual piece of timber is clearly marked to show the treatment type, e.g. 'ACQ, Copper Azole, LOSP' or other similar text as appropriate. In some instances, (e.g. high use public

areas), Council will require these markings to be burn branded into exposed timber areas also. In this regard reference should also be made to Council specific standard drawings for additional marking of treated timber elements that are used in the construction of Council assets in high use public areas.

DG 10.10 Crime Prevention through Environmental Design

10.10.1 It is important when designing parks that the principles of crime prevention through environmental design are considered, in particular:

10.10.1.1 Dense stands of vegetation should be confined to park peripheries, and should not be located alongside paths and play equipment. Vegetation should not block casual surveillance of picnic and play areas from adjacent residences;

10.10.1.2 Landscaping should not restrict sightlines and opportunities for natural surveillance within and of a site therefore all new vegetation around centres of activity should be single clean trunked trees with shrubs which do not grow beyond 500 mm height. This will avoid the problem of concealment and allow a greater area of surveillance from the road;

10.10.1.3 Lighting where required should be sufficient to deter loitering and vandalism; Large shrubs and trees should be planted in such a way as to prevent or reduce illicit access to buildings and neighbouring properties; and

10.10.1.4 Safety in large parks or areas of vegetation within a development may be enhanced by planting trees in thin strips which maximises the number of trees planted but which also restricts the ability of offenders to hide within a “mass” of vegetation.

DG 10.11 Treatment to Park Boundaries

10.11.1 Vehicles should be prevented from driving into parks, drainage reserves and public open spaces by the provision of barriers along the road frontages. These may be log barriers, bollards or natural features such as existing vegetation or newly planted and staked trees. Access for maintenance vehicles shall be provided through a lockable gate or removable bollard.

10.11.2 Definition of the park side boundaries should be indicated by installing log barrier fencing or bollards at approximately 20 metre centres, down each side. These should be offset from the surveyed boundary by 100 mm in order to allow future erection of private fencing without having to remove Council’s markers. Definition of the park boundary is intended to deter encroachment onto park by adjacent private properties and to define the park limits.

10.11.3 Log barriers and bollards shall be in accordance with Council’s Standard Drawing, unless otherwise approved by Council.

DG 10.12 Internal Circulation

10.12.1 The park layout should be designed to ensure that internal circulation or movement within the park is:
- 10.12.1.1 Safe;
- 10.12.1.2 Unencumbered;
- 10.12.1.3 Highly visible internally and externally; and
- 10.12.1.4 Linked to external cycle and pedestrian networks.

10.12.2 Design features including access points, street frontages, carparks, pedestrian/bike paths, park equipment and lighting should be considered.

10.12.3 Design of paths, car parking and access points should consider the needs of people with mobility challenges. Pathways shall be in accordance with Design manual D1 and comply with accessibility standards.

DG 10.13 Planting

10.13.1 Council parks seek to provide a range of recreation opportunities and there is scope to utilise planting design to help achieve this objective, options include:
- 10.13.1.1 Shade trees evenly planted throughout the site to maximise protection from the sun;
- 10.13.1.2 Island or corridor planting to concentrate trees for easy maintenance and encourage bird life for pleasure viewing;
- 10.13.1.3 Grouped planting will also provide shade adjacent to open space to allow unencumbered active play areas; and
- 10.13.1.4 Lines of tree planting to define edges of informal kick-about areas.

10.13.2 A minimum 75% of the proposed tree planting should be endemic, and species should be selected on their adaptability to site conditions, and their value to local fauna. Where the proposed park adjoins an area of established native vegetation, an extension of this habitat into the park should be implemented by using compatible species. The designer should also be encouraged to use rare and endangered plant species, or species proven to have excellent bird, butterfly and insect attracting qualities.

10.13.3 In order to promote the unique landscape characteristics of the region exotic flowering trees and non-native palms should only be used as features or emphasis, where necessary.

10.13.4 Some Local Authorities have plant selection guidelines and suburban planting themes and designers are encouraged to consult with Council in the preparation of the landscaping design.

10.13.5 Street trees should not be a plant listed in:
- 10.13.5.1 Land Protection (Pest and Stock Route Management) Regulation;
- 10.13.5.2 Local governments Pest Management Plan; and

10.13.5.3 Publication, Agricultural and Environmental Weeds (Wet Tropics Management Authority).

DG 10.14 Grassing

10.14.1 All parks shall be covered with topsoil to a depth of not less than 50mm and shall be lightly compacted and grassed in accordance with Councils' minimum standards and specifications.

10.14.2 In order to guarantee a high standard of maintenance all parks shall be in a mowable condition, free from rocks and loose stones, and graded to evenrunning contours.

10.14.3 Grass should be established within the proposed park as quickly as possible in order to avoid erosion and sedimentation to the local waterways, and prevent the establishment of weeds in accordance with Council's Manuals and Specifications.

DG 10.15 Mounding

10.15.1 Mounding may be used within the park design to provide topographical interest, to emphasise views, to help screen adjacent properties or eyesores, or as part of the internal design. The mounds should not exceed a gradient of 25% (1 in 4) in order to reduce erosion and allow mowing. Planting of trees and shrubs over the mound will further emphasise height and shape.

10.15.2 Care should be given to ensuring that the mound does not restrict visibility into and out of the park thus threatening the safety of users or provide unwanted visibility into private properties.

DG 10.16 Furniture

10.16.1 Park furniture should reflect the intended function of the park and compliment any distinguishing features present e.g. seating situated to maximise a view scape. Some preferred features of furniture include:

10.16.1.1 Park benches located under a natural or built shade structure to allow day long use. If the shade is built, it should have an impervious roof e.g. colourbond to provide shelter during rain;

10.16.1.2 Well drained ground and hard surfacing below any structure. Surface material could be pavers, coloured or exposed aggregate concrete etc;

10.16.1.3 Shade structures should maximise protection from the sun during the hours of 11 am - 3 pm; and

10.16.1.4 Refuse bins should be located for ease of use and pickup by refuse trucks e.g. adjacent to playgrounds or picnic areas, at park exits.

10.16.2 Designs of furniture should reflect a strong aesthetic and vandal resistant appearance.

10.16.3 Where possible, natural features may be used e.g. mounding for seating, trees or natural rock for bollards to simulate park furniture; and

10.16.4 Some Local Authorities have park furniture themes and master plans designers are encouraged to consult with Council in the preparation of the landscaping design.

DG 10.17 Signage and Interpretation

10.17.1 A park name sign is to be provided. The park name is to be submitted to Council for approval with the landscaping drawings. The proposed name is to preferably have the same theme as the subdivision's street names. The name is to be creative and imaginative in order to appeal to children for local parks and to adults for district and regional parks.

10.17.2 If the park has any historic, cultural or natural value the provision of interpretive signage will provide further interest to local users. Council can provide assistance in developing interpretive concepts

DG 10.18 Lighting

10.18.1 Lighting requirements within parks will be advised by Council in accordance with the classification of the park.

10.18.2 As a guide 2 park lights on poles shall be provided for every park of 4,000 square metres. However, this may vary depending upon the shape and alignment of the park, and the presence of existing vegetation. Generally, parks should be well lit providing a safe nocturnal environment for local users. Council will consider the relaxation of one or both lights where existing street lights are adjacent to the park area. Underground power should be provided to each pole. Light fittings should be vandal resistant.

10.18.3 Pathways within parks that require lighting shall be lit to the lighting category determined from the road Lighting Standards AS/NZS 1158.3 Pedestrian area (Category P) lighting.

DG 10.19 Provision of Water

10.19.1 Facilities for drinking, such as drinking tap / bubbler, shall be provided for each park area, and should be located near active recreational areas, adjacent to a well-used access route, and within an area serviceable from the road frontage.

A soak-away trench shall be provided to the base of each tap to prevent ponding and waterlogging.

10.19.2 In order to irrigate the park 1 water service connection in a cast iron valve box should be provided for each 2,000 square metre of park and should be a minimum 40 mm diameter with hose connection.

10.19.3 As an alternative, irrigation may be provided, on condition that the proposed system complies with the Council Standard Specification for Irrigation.

DG 10.20 Water Features

10.20.1 Water features should not be included in infrastructure to be handed to Council.

DG 10.21 Playgrounds

10.21.1 To ensure play equipment is as safe as possible and appropriate for the intended users, it should conform to the current and relevant Australian Standards for playgrounds and play areas and additional standards as may be established by Council.

10.21.2 Where playground equipment is required by Council as a condition of the development permit of the subdivision, or proposed to be installed by the developer, the following requirements should be considered and incorporated into the design:

10.21.2.1 Type of play equipment proposed should be selected in consultation with Council;

10.21.2.2 The age range of the users should influence the type of equipment provided; and

10.21.2.3 The siting of the playground should not infringe upon adjacent residential properties; a minimum distance of 10 metres between equipment and park boundaries should be provided and suitably landscaped with a minimum of 3 metre of screen planting to reduce noise and visual impact. Such landscaping is to be consistent with CPTED Principles.

10.21.3 To conform to safety requirements impact absorbing surfacing should be installed to the play area, e.g. sand, continuous rubberised matting, shredded car tyres.

10.21.4 Shade cover over playgrounds is to be provided, in order to encourage day long use. Preferably this should be a permanent shade structure approved by Council, however shade trees planted at maximum 6 metre centres around the safety area are acceptable.

10.21.5 The provision of seating overlooking the playground will be required.

10.21.6 Bench seating should be of the recycled plastic or aluminium type.

DG 10.22 Maintenance

10.22.1 The design of a park should carefully consider long-term maintenance requirements. Mulched garden beds containing trees and shrubs are easier to mow around than numerous small trees and shrubs planted individually throughout the grassed areas.

10.22.2 Where single shade trees occur they should be mulched to 200 mm depth in a minimum 1.2 metre diameter circle, thus avoiding damage to trunks by mowers or whipper snippers.

10.22.3 Access to the parks, drainage reserves and public open spaces for maintenance vehicles should be via a lockable gate or removable bollards.

10.22.4 A maintenance programme is required to be submitted to Council with the submission of the landscape designs. The programme should be prepared by the Landscape Architect / Designer and should detail all proposed maintenance works.

Irrigation

DG 10.23 General

10.23.1 All irrigation systems connected to Council's water supply shall be installed to satisfaction of Council. The installation of water meters, backflow prevention device and isolation valves are mandatory in all irrigation system. Refer AS 3500.

10.23.2 The installation of an irrigation system to all landscaped traffic islands and roundabouts is mandatory.

10.23.3 An irrigation plan prepared by an irrigation consultant, shall be submitted to Council for approval together with the landscaping plans, and the proposed planting plans for the traffic islands / roundabouts.

10.23.4 The design of all watering systems must ensure an efficient and economical application of water. Such systems are to be designed to use low water application, and shall run only during Council's nominated times.

10.23.5 The irrigation system shall use the following components and shall be installed in accordance with Council Specifications:

10.23.5.1 A backflow prevention unit, installed to the requirements of AS 3500;

10.23.5.2 20mm, 25mm or 32mm or 40mm diameter blue line poly pipework (as required) to garden bed areas; laid in a ring around the periphery of each garden bed;

10.23.5.3 Pop-up sprinklers to periphery of garden beds. Fixed shrub heads to centre of islands only; and

10.23.5.4 Automatically operated controller in PVC box laid flush with finished ground level.

10.23.6 All irrigation pipework installed under roadways shall be laid in minimum 100mm dia. uPVC Class 9 conduit.

10.23.7 The water connection and installation of the irrigation system shall be carried out by Council personnel or an approved contractor at the developers / applicants cost. The maintenance period for irrigation works shall be 12 months and shall run concurrently with the "On Maintenance" / establishment period for landscaping works. Thereafter all maintenance and watering will be the responsibility of the Council.

10.23.8 The installation of an irrigation system on Council property, other than buffer mounds, traffic islands and roundabouts, e.g. verges will not be permitted unless:

10.23.8.1 The system is separate from the development and all pipework is located adjacent to the kerb and channel; and

10.23.8.2 Or the verge is irrigated from sprinklers that fall within the development property boundaries.

10.23.9 These requirements have come about in order to prohibit the installation of water lines across the underground services located within the verge. These water lines would not appear in Council records and are therefore at risk of breakage during service repair work/trench excavation.

10.23.10 If a separate irrigation system within the verge is desired, the developer will be required to pay all installation costs, which include:

10.23.10.1 Tapping into main;

10.23.10.2 Installation of 25mm diameter (typical) backflow prevention device;

10.23.10.3 Installation of pipework and pop-up sprinklers; and

10.23.10.4 Installation of solenoid valves and automatic controller.

SG – Specification Guidelines

SG 1 – Earthworks

General

SG 1.1 Scope

1.1.1 This specification details all requirements pertaining to earthworks operations associated with construction sites. This specification excludes earthworks associated with roadworks construction.

1.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

1.1.3 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

SG 1.2 Reference Documents

1.2.1 Australian Standards:

1.2.1.1 AS 3798 Guideline on Earthworks for Commercial and Residential Developments

Materials

SG 1.3 Topsoil

1.3.1 Topsoil is defined as surface soils normally high in organic matter and contaminated by residual grass seed and grass roots. Topsoil shall be free from large roots, stones, rocks and unsuitable material as defined below.

SG 1.4 Unsuitable Material

1.4.1 Reference is made to AS 3798 Section 4.2 "Unsuitable Materials" for definitions and guidelines regarding unsuitable materials with regard to earthworks operations.

SG 1.5 Suitable Material

1.5.1 Reference is made to AS 3798 Section 4.3 "Suitable Materials" for the definition and guidelines regarding acceptable materials for earthworks operations.

Construction

SG 1.6 General

1.6.1 Specific reference is made to AS 3798 in relation all activities pertaining to earthworks operations. Specific construction details are noted in Section 6 of AS 3798 and all appropriate methods of testing, frequency of testing and reporting procedures are to be in accordance with this Australian Standard.

SG 1.7 Protection of Earthworks

1.7.1 The Contractor's responsibility for care of the works shall include the protection of earthworks in accordance with the approved Erosion and Sediment Control Strategy.

1.7.2 The Contractor shall install effective erosion and sedimentation control measures, prior to commencing earthworks, and shall maintain these control measures as required.

1.7.3 Adequate drainage of all working areas shall be maintained throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of a planned erosion and sedimentation control system.

1.7.4 When rain is likely or when work is not proposed to continue in a working area on the following day, precautions shall be taken to minimise ingress of any excess water into earthworks material. Ripped material remaining in cuttings and material placed on embankments shall be sealed off by adequate compaction to provide a smooth tight surface.

1.7.5 Should insitu or stockpiled material become over wet as a result of the Contractor not providing adequate protection of earthworks, the Contractor shall be responsible for replacing and/or drying out the material and for any consequent delays to the operations.

SG 1.8 Clearing and Grubbing

1.8.1 Clearing and grubbing operations shall be in accordance with AS 3798 Section 6.1.4.

1.8.2 The extent of clearing and grubbing shall be taken to mean the removal and disposal of:

- 1.8.2.1 Trees, Shrubs and overhanging branches, both living and dead;
- 1.8.2.2 Tree stumps and roots to a depth not less than 300mm below ground surface;
- 1.8.2.3 Rocks, rubbish and other artificial obstructions from the ground surface;
- 1.8.2.4 Abandoned services to a depth not less than 300mm below ground surface;
- 1.8.2.5 Old foundations, buildings and structures;
- 1.8.2.6 Minor made structures (such as fences);
- 1.8.2.7 Other materials, which are unsuitable for use in the works.

1.8.3 Un-grubbed rocks under embankments may be left undisturbed providing there is a depth of at least 600mm of earth covering over them when the filling operations are completed.

1.8.4 Unless otherwise specified or directed, the area to be cleared is the minimum width required to construct the works plus a margin of 2m beyond tops of cuts and toes of embankments. The area to be cleared and grubbed should be shown on a plan, preferably the Erosion and Sediment Control Plan.

1.8.5 Any trees, shrubs and overhanging branches identified on the Project Drawings to be retained or protected shall be clearly marked by the contractor prior to commencing clearing operations.

1.8.6 Beyond the areas to be cleared only those trees, shrubs and over hanging branches which directly interfere with the construction of the works shall be removed or pruned as necessary.

SG 1.9 Topsoil Operations

1.9.1 Stripping of topsoil shall be in accordance with AS 3798 Section 6.1.5.

1.9.2 Removal of topsoil shall only commence after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the Works.

1.9.3 Topsoil throughout the extent of the work shall be removed and stockpiled separately clear of the work with care taken to avoid contamination by other materials.

1.9.4 Topsoil material stripped from the site shall be stockpiled for later use in spreading on footpaths, allotments and parkland areas.

1.9.5 Topsoil stockpiles shall not contain any timber or other rubbish and shall be trimmed to a regular shape.

1.9.6 To minimise erosion, stockpiles are to be protected by effective usage of erosion and sediment control devises, which are to be defined within the Erosion and Sediment Control Management Plan.

1.9.7 Where seeding of stockpiles to encourage vegetation cover is specified, such work shall be carried out in accordance with the Specification S8 LANDSCAPING.

1.9.8 Nominally 75mm depth of topsoil is to be re-spread over such areas with an absolute minimum of 40mm material to be provided in any one location.

SG 1.10 General Earthworks

1.10.1 Placement and Compaction of earthworks shall be in accordance with AS 3798 Sections 5 and 6.

1.10.2 The methods of testing and frequency of testing shall be in accordance with AS 3798 Sections 7 and 8.

1.10.3 Unless a higher level of testing is specified or directed the minimum level of geotechnical testing services to be accorded earthworks activities shall be as determined by Level 2 in Appendix B of AS 3798.

1.10.4 All testing is to be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

SG 1.11 Excavations

1.11.1 Materials encountered in excavation shall be loosened and broken down as required so that they are acceptable for incorporation in the works.

1.11.2 All excavations shall be constructed to the shape and slopes shown on the approved Project Documents.

1.11.3 Batter shall be trimmed neatly to the shapes specified and shall be free of loose or unstable material.

1.11.4 Horizontal tolerances for the excavation of batters, measured at right angles to the batter line, shall be – 50mm +250mm (where the + tolerance is in the direction which increases the width of excavation).

1.11.5 Vertical tolerances for all excavation shall be ± 50mm.6. When completed all culvert excavations, benches, berms and drains shall be free draining.

1.11.6 At all times the requirements of the Workplace Health and Safety Act shall be complied with and all works shall be made safe during the performance of such activities.

SG 1.12 Embankments/Fill Areas

1.12.1 All embankments and fill areas shall be constructed to the shape and slopes shown on the approved Project Documents.

1.12.2 When completed, the average planes of the batters of embankments shall conform to those shown on the approved Project Documents.

1.12.3 Horizontal tolerances for the embankment batters, measured at right angles to the batter line, shall be – 0mm +250mm (where the + tolerance is in the direction which increases the width of embankment).

1.12.4 Vertical tolerances for all embankments / fill areas, shall be ± 50mm except where such fill defines the subgrade level for a structure, then the vertical tolerances are to be +15mm – 30mm.

1.12.5 When completed all embankments / fill areas shall be free draining.

1.12.6 At all times the requirements of the Workplace Health and Safety Act shall be complied with and all works shall be made safe during the performance of such activities.

1.12.7 Stabilise final embankment and fill areas with suitable revegetation, landscaping, turf or grass seeding. These areas and works should be shown in the landscape plans.

SG 1.13 Trenching Operations

1.13.1 The excavation for trenches shall be taken out to the exact alignment, width and level as shown on the Project Drawings and associated specifications.

1.13.2 Trenches shall not be excavated wider than the dimensions shown on these relevant drawings and the Contractor shall take all precautions as necessary to ensure that the excavation is made in a careful manner and that it is rendered secure and safe by all appropriate means.

1.13.3 At all times the requirements of the Workplace Health and Safety Act shall be complied with and all works shall be made safe during the performance of such activities.

1.13.4 Suitable drainage shall be accorded to all trenching activities and de-watering of trenches shall be undertaken should infiltration of water occur. All materials excavated from trenches shall be separated by material type for latter inclusion into the works or disposal from the site should these materials be deemed unsuitable in accordance with the requirements of AS 3798.

1.13.5 Excavation and trenching operations shall proceed with sufficient resources to ensure uninterrupted progress and continuance of the works with subsequent services. Completion and backfilling are to be undertaken as soon as possible to minimise the extent of site open to the effects of the environment.

SG 2 – Road Pavements

General

SG 2.1 Scope

1.1.1 This specification details all requirements pertaining to the construction of flexible road pavements, including kerbing, subsoil drainage and trimming of verges.

1.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

SG 2.2 Reference Documents

2.2.1 Australian Standards:

- 2.2.1.1 AS1289 Methods of Testing Soils for Engineering Purposes
- 2.2.1.2 AS2439.1 Perforated Drainage Pipe and Associated Fittings
- 2.2.1.3 AS3706.7 Determination of Pore-sized Distribution – Dry Sieving Methods

2.2.2 All Australian Standards referenced in this specification shall be the current edition.

2.2.3 Department of Main Roads Standard Specifications

- 2.2.3.1 MRS 11.03 Drainage, Retaining Structures and Protective Treatments
- 2.2.3.2 MRS 11.04 General Earthwork
- 2.2.3.3 MRS 11.05 Unbound Pavements
- 2.2.3.4 MRS 11.11 Sprayed Bitumen Surfacing (Excluding Emulsions)
- 2.2.3.5 MRS 11.14 Road Furniture
- 2.2.3.6 MRS 11.17 Bitumen
- 2.2.3.7 MRS 11.19 Bitumen Cutter and Flux Oils
- 2.2.3.8 MRS 11.20 Cutback Bitumen
- 2.2.3.9 MRS 11.22 Supply of Cover Aggregate
- 2.2.3.10 MRS 11.30 Dense Graded Asphalt Pavements
- 2.2.3.11 MRS 11.45 Pavement Marking Department of Main Roads Publications
- 2.2.3.12 Manual of Uniform Traffic Control Devices)

SG 2.3 Pavement Material

2.3.1 Pavement materials used for pavement construction shall comply with Table S2.1 unless otherwise approved by the relevant authority.

Table S2.1 Pavement Materials

Pavement Material	Type of Material Permissable	Grading	CBR (Minimum)
Subgrade Replacement	Type 2.5	B, C or D	15
Sub-base (for Access Places and Access Streets)	Type 2.3	B, C or D	45
Sub-base (for all roads of Major Collector or higher in the hierarchy)	Type 2.2	B, C or D	60
Base (for Access Places and Access Streets)	Type 2.2	B, C or D	60
Base (for all roads of Major Collector or higher in the hierarchy)	Type 2.1	B or C	80

2.3.2 All references to material type in the above table refer to the Main Roads Standard Specification MRS11.05 "Unbound Pavements".

2.3.3 All materials shall be sourced from a Quality Assured material supplier and the results of the manufacturer's testing to assure the quality of the product shall be incorporated with the Contractor's Quality records.

SG 2.4 Asphaltic Concrete Surfacing

2.3.4 For surfacing on pavements with nominal depth 30mm, the material quality requirements, material quality compliance testing requirements and all other matters pertaining to Asphaltic Concrete road pavement surfacing shall conform to the requirements as specified in Austroads.

2.3.5 For surfacing on pavements with nominal depths greater than 30mm, the material quality requirements, material quality compliance testing requirements and all other matters pertaining to Asphaltic Concrete road pavement surfacing shall conform to the appropriate Main Roads Standard Specification (Main Roads Specification MRS 11.30 "Dense Graded Asphalt Pavements").

SG 2.5 Sprayed Bitumen Surfacing

2.5.1 For surfacing of pavements with sprayed bitumen. the material quality requirements, material quality compliance testing requirements and all other

matters pertaining to hot bitumen road pavement surfacing shall conform to the appropriate Queensland Department of Main Roads Specification:

2.5.1.1 Main Roads Specification MRS 11.11 "Sprayed Bitumen Surfacing (Excluding Emulsions)"
2.5.1.2 Main Roads Specification MRS 11.17 " Bitumen"
2.5.1.3 Main Roads Specification MRS 11.19 " Bitumen Cutter and Flux Oils"
2.5.1.4 Main Roads Specification MRS 11.20 " Cutback Bitumen"
2.5.1.5 Main Roads Specification MRS 11.22 "Supply of Cover Aggregate"

SG 2.6 Concrete Interlocking Pavers

2.6.1 Concrete interlocking pavers shall be manufactured and supplied in accordance with the requirements of Specification S3 SEGMENTAL PAVING.

SG 2.7 Road Furniture

2.7.1 The manufacture, supply and material requirements appropriate to the specification for Road Signs and guidepost shall be as per the Main Roads Standard Specification "MRS11.14 Road Furniture".
2.7.2 All signs to be Class 1 reflectivity.
2.7.3 Signs located in concrete islands or medians shall be supplied with the "V Loc" socket system and fitted with anti-theft bolts.

SG 2.8 Pavement Marking

2.8.1 The manufacture, supply and material requirements appropriate to the specification for Pavement Marking shall be as per the Main Roads Standard Specification "MRS11.45 Pavement Marking".

Construction

SG 2.9 Inspection, Sampling & Testing

2.9.1 Inspection, sampling and testing of the pavement shall be in accordance with the requirements of this specification before, during and after the construction of the pavement.
2.9.2 All testing shall be carried out by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

SG 2.10 Setout

2.10.1 The construction set-out for roadworks construction shall be by reference to a datum line established by a Registered Surveyor. The datum line may be either the road centreline, a pegged chainage offset line or any alternative datum suitable for the purposes of accurately setting out the roadworks in accordance with the drawings for the works.

SG 2.11 Clearing & Grubbing

2.11.1 All clearing and grubbing works shall be in accordance with the Specification for SG 1 EARTHWORKS.

SG 2.12 Topsoil Operations

2.12.1 All topsoil operations associated with roadworks construction (topsoil stripping, stockpiling and re-spreading), shall be in accordance with the Specification for SG 1 EARTHWORKS.

SG 2.13 Earthworks

2.13.1 All earthworks operations up to subgrade level shall comply with the requirements detailed in Main Roads Standard Specification MRS11.04 "General Earthworks".

SG 2.14 Trim and Compact Subgrade

2.14.1 The subgrade material is defined as the top 300mm of earthworks profiled and compacted upon which pavement materials are to be placed. The subgrade material shall be compacted in accordance with the requirements detailed in Main Roads Standard Specification MRS11.04 "General Earthworks", with the testing frequency and requirements are detailed herein.

2.14.2 The subgrade material shall be compacted to provide a relative compaction determined by AS1289 for a standard compactive effort as follows:

2.14.2.1 Minimum Dry Density Ratio (Cohesive soils) - 98%

2.14.2.2 Minimum Density Index (Cohesion less soils) - 80%

2.14.3 Testing frequency not less than one (1) test per 1000m^2 with a minimum number of three (3) tests per sample area being tested.

2.14.4 At least one (1) sample area shall be tested for type of subgrade material evident on site.

2.14.5 The subgrade material shall not include any "Unsuitable Material" as defined in Main Roads Standard Specification MRS 11.04 "General Earthworks" and shall be trimmed to the profile required to conform with the Project Drawings and the tolerances specified herein.

2.14.6 Where unsuitable material is encountered in the subgrade, a suitable "Subgrade Replacement Material" in accordance with the requirements of this specification shall be incorporated in the works.

2.14.7 In this instance, the unsuitable material shall be excavated to a level sufficient to obtain a sound foundation for the pavement. The compaction requirements and testing frequency noted previously shall apply to all operations involving any subgrade replacement material required for the works.

2.14.8 The tolerances appropriate to the construction of subgrade and to subgrade replacement material shall comply with the following:

2.14.8.1 Design Level Tolerance +15mm, - 30mm

2.14.8.2 Shape Tolerance of 25mm maximum deviation from a 3m straight edge laid in any direction.

2.14.9 Following completion of subgrade compaction, trimming, and satisfactory density testing, the whole of the subgrade area shall be inspected by proof rolling with a fully loaded single rear axle truck with a minimum axle loading of 8 tonne (or acceptable equivalent). Acceptable proof rolling shall be taken to be no visible signs of deformation or instability in the subgrade.

SG 2.15 Pavement Courses

2.15.1 The pavement course materials (Base Course and Sub-base Course) shall be transported from the material supplier to the spreading area without segregation and shall be placed at the correct moisture content.

2.15.2 The pavement course materials shall be spread in uniform loose layers on the prepared subgrade, subgrade replacement, or sub-base course and compacted to conform with the grades, profiles and cross sections as indicated on the Project Drawings and to the tolerances and compaction standards specified herein.

2.15.3 The thickness of any loose layers shall be such that after compaction it shall not be less than 100mm nor more than 200mm thick. Appropriate compaction equipment shall immediately follow the spreading and shaping of the loose materials and under no circumstances shall the materials be allowed to dry out before compaction.

2.15.4 After compaction of each pavement course, the whole of the surface shall be watered and rolled with a steel drum roller to give a hard, dense, tightly packed surface free of lenses, compaction planes and caking, in accordance with the tolerances specified herein.

2.15.5 No placement of base course material on the sub-base shall commence until the compaction standards and tolerances for construction of the lower layer have been inspected and confirmed satisfactory. [Hold Point].

2.15.6 The pavement course material shall be compacted to provide a relative compaction determined by AS1289 for a standard compactive effort as follows:
2.15.6.1 Base Course - 100%
2.15.6.2 Sub-base Courses - 100%

2.15.7 Testing frequency not less than one test per 500m^2 with a minimum of four (4) tests per sample area being tested for sand replacement method and two tests per 500 m^2 with a minimum" of eight (8) tests per sample for nuclear test.

2.15.8 The tolerances for the construction of the pavement courses shall comply with Table S2.2.

Table S2.2 Construction Tolerances

Course	Design Level Tolerance	Layer Thickness Tolerance	Shape Tolerance
Sub-base	+20mm -20mm	+40mm -20mm	25mm in 3m maximum
Base	+10mm -10mm	+15mm -15mm	15mm in 3m maximum
Overall	+20mm -10mm	+20mm -10mm	

SG 2.17 Asphaltic Concrete Surfacing

2.17.1 For Asphaltic Concrete surfacing with a nominal depth 30mm, the construction requirements, method of construction works, and compliance testing requirements for Asphaltic Concrete surfacing, shall be in accordance with Austroads

2.17.2 For Asphaltic Concrete surfacing with a nominal depth greater than 30mm, the construction requirements, method of construction works, and compliance testing requirements for Asphaltic Concrete surfacing, shall be in accordance with Main Roads Specification MRS 11.30 "Dense Graded Asphalt Pavements".

2.17.3 All roads greater than 10% gradient shall have a 10mm primer seal or applied to the base course prior to the placement of the Asphaltic Concrete. Alternate methods where approved by Council shall be as noted on the approved Project Drawings.

2.17.4 The tolerances appropriate to Asphaltic Concrete surfacing shall comply with the following:
2.17.4.1 Design Level Tolerance - +10mm, - 10mm
2.17.4.2 Layer Thickness Tolerance - +15mm, - 0mm
2.17.4.3 Shape Tolerance - 7mm in 3m Maximum (Any direction).

SG 2.18 Sprayed Bitumen Surfacing

2.18.1 The construction requirements, method of construction works, and compliance testing requirements for Hot Sprayed Bitumen surfacing, shall be in accordance with the following Queensland Department of Main Roads Specifications:

- 2.18.1.1 Main Roads Specification MRS 11.11 "Sprayed Bitumen Surfacing (Excluding Emulsions)"
- 2.18.1.2 Main Roads Specification MRS 11.17 " Bitumen"
- 2.18.1.3 Main Roads Specification MRS 11.19 " Bitumen Cutter and Flux Oils"
- 2.18.1.4 Main Roads Specification MRS 11.20 " Cutback Bitumen"
- 2.18.1.5 Main Roads Specification MRS 11.22 "Supply of Cover Aggregate"

SG 2.19 Concrete Segmental Pavers

2.19.1 Concrete interlocking pavers shall be constructed in accordance with the requirements of Specification S3 SEGMENTAL PAVING.

SG 2.20 Kerbing and Channelling

2.20.1 Concrete kerb, kerb and channel shall be constructed by a continuous slip form extrusion machine true to line and grade and to the profile for each kerb type in accordance with the Council's Standard Drawing.

2.20.2 Kerbing shall be constructed on sub base material compacted to 100% standard compaction as determined in accordance with the relevant Test Methods contained in AS 1289.

2.20.3 The finished kerbing shall be well compacted and shall have exposed surfaces free from voids and honeycombing.

2.20.4 Contraction joints shall be made at regular intervals not exceeding 3m. The joints shall be made by forming grooves 40mm deep and not more than 6mm wide in all exposed surfaces of the kerb and kerb and channel. All grooves shall be normal to the top surfaces and square to the alignments of the kerb and kerb and channel.

2.20.5 The horizontal and vertical alignments of the kerb and kerb and channel shall not vary from the design level by more than + 10mm, provided that:

- 2.20.5.1 The difference between the deviations from correct levels at any two points 30m apart shall not exceed 30mm
- 2.20.5.2 The deviation from a straight edge laid parallel to the centreline shall not exceed 10mm in 3m.

2.20.6 The invert of all channels shall be finished true to grade and alignment and no channelling in which water is found to pond will be accepted.

2.20.7 Any kerb or kerb and channel not true to line or with noticeable kinks, bends or other faults, or not of the required dimensions (considering the tolerances

specified herein), may be condemned and shall be broken out and removed from site.

SG 2.21 Subsoil Drainage

2.21.1 Unless otherwise detailed on the Project Drawings subsoil drainage shall be constructed beneath the kerbing on an alignment as shown on Council's Standard Drawing.

2.21.2 Subsoil drainage trenches, drainage pipe, backfill material, geotextile shall be constructed in accordance with the requirements of Main Roads Standard Specification MRS 11.03 "Drainage, Retaining Structures and Protective Treatments".

2.21.3 Subsoil Drainage cleanouts shall be constructed in accordance with the requirements of Council's Standard Drawing and shall preferably, be located with the upstream flushing point internally within a stormwater gully pit or manhole.

SG 2.22 Trim Verges and Batters

2.22.1 Following completion of all earthworks operations associated with roadworks construction, all verges and fill batters shall be graded and trimmed to the line and level indicated on the Project Drawings. Allowance shall be made in the final trimming operations for topsoiling and grassing activities.

2.22.2 Cut batters shall be lightly tined to a depth of 25 - 50mm prior to respreading of topsoil material.

SG2.23 Road Furniture and Pavement Marking

2.23.1 The construction of all Road Signs and associated Road Furniture shall comply with the requirements of the following:

- 2.23.1.1 Main Roads Standard Specification MRS 11.14 "Road Furniture"
- 2.23.1.2 Main Roads "Manual of Uniform Traffic Control Devices"
- 2.23.1.3 Council's Standard Drawing for Street Name Signs.
- 2.23.1.4 Council's Standard Drawing for Traffic Control Devices.

2.23.2 All Pavement Marking shall comply with the requirements of Main Roads Standard Specification MRS 11.45 "Pavement Marking".

SG 3 – Segmental Paving

General

SG 3.1 Scope

3.1.1 This specification details all matters pertaining to the construction of both clay and concrete segmental paving for road pavements, medians, traffic islands, driveways, cycle ways, footpaths and other pedestrian areas.

3.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

SG 3.2 Reference Documents

3.2.1 Australian Standards
- 3.2.1.1 AS1012 Method of Testing Concrete
- 3.2.1.2 AS1141.1 Particle Size Distribution of Dry Sieving
- 3.2.1.3 AS/NZS4455 Masonry Units and Segmental Pavers
- 3.2.1.4 AS/NZS4456 Masonry Units and Segmental Pavers – Methods of Test – General Introduction and list of Methods

3.2.2 Concrete Masonry Association of Australia Specifications
- 3.2.2.1 T44 Concrete Segmental Pavements - Guide to Specifying
- 3.2.2.2 T45 Concrete Segmental Pavements – Design Guide for Residential Access Ways and Roads
- 3.2.2.3 T46 Concrete Segmental Pavements – Detailing Guide

Materials

SG 3.3 Concrete Segmental Pavers

3.3.1 Concrete segmental pavers are units of not more than 0.10 square metres in gross plan area, manufactured from concrete, with plain or dentated sides, with top and bottom faces parallel and with or without chamfered edges.

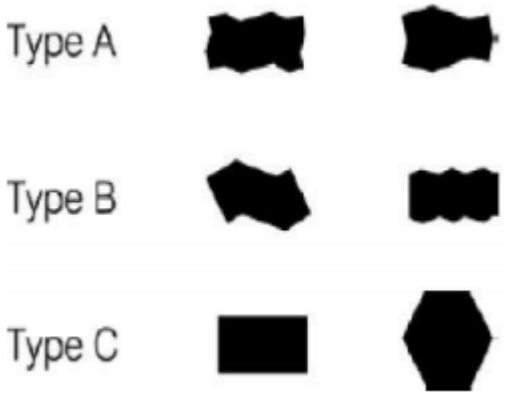
3.3.2 Concrete pavers are identified by shape as being one of the following types:
- 3.3.2.1 Shape Type A: Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by their plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units.
- 3.3.2.2 Shape Type B Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by their plan geometry,

when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on their dimensional accuracy and accuracy of laying to interlock on the other faces.

3.3.2.3 Shape Type C Units which do not key together and which rely on their dimensional accuracy and accuracy of laying to develop interlock.

3.3.3 Figure S3.1 shows examples of some of the more common shapes.

Figure S3.1 Paver Shapes



3.3.4 Concrete segmental pavers shall comply with the requirements of T44, T45, T46, and AS/NZS 4455 for each area of application.

3.3.5 The material requirements for concrete pavers for each application, derived from T44, are shown in Table S3.1.

3.3.6 The pavers shall meet the requirements for the relevant application given in Table S3.1 when tested in accordance with the test methods outlined in AS/NZS 4456.

Table S3.1 Material Requirement for Concrete Segmental Pavers

Application	Characteristic breaking load[2] (kN)	Characteristic flexural strength[2] (MPa)	Minimum Thickness (mm)	Shape[3]	Dimensional deviations (Cat AS455)	Abrasion Resistance (mean abrasion]
Residential Driveways **Light Traffic** **Medium Traffic[1]**	3 5	2 3	No Limit No Limit	Any Any	DPA1 or DPB1 DPA1 or DPB1	7 7
Public Footpaths **Low Volume** **High Volume and**	5 5	3 3	No Limit No Limit	Any Any	DPB2 DPB2	5 3.5

Pedestrian Malls[1]						
Roads[3] All Roads	5	3	80	A	DPB2	5

Notes:

1. **Capable of taking occasional 8.2-t axle loads**
2. **At 28 days**
3. **Interlocking shapes offer superior performance in road applications**

SG 3.5 Bedding Sand

3.5.1 The bedding sand shall be well graded sand, consisting of clean, hard, uncoated grains uniform in quality, generally passing a 4.75mm sieve and shall conform with the grading limits specified in Table S3.2.

Table S3.2 Bedding Sand Grading Limits

AS Metric Sieve (mm)	% Passing
9.52	100
4.75	95-100
2.36	80-100
1.18	50-85
0.600	25-60
0.300	10-30
0.150	5-15
0.075	0-10

3.5.2 The sand shall be of uniform moisture content when spread. It shall be covered when stored on site to protect it from rain penetration.

3.5.3 The bedding sand shall be free of deleterious soluble salts or other contaminants, which may cause, or contribute to, efflorescence.

SG 3.6 Joint Filling Sand

3.6.1 The joint filling sand shall be well graded passing a 2.36mm sieve, and shall conform with the grading limits specified in Table S3.3.

Table S3.3 Joint Filling Sand Grading Limits

AS Metric Sieve (mm)	% Passing
2.36	100
1.18	90-100
0.600	60-90
0.300	30-60

0.150	15-30
0.075	5-10

3.6.2 The sand shall be dry when spread. It shall be covered when stored on site to protect it from rain penetration.

3.6.3 The sand shall be free of deleterious soluble salts or other contaminants, which may cause, or contribute to, efflorescence.

3.6.4 Sand used for bedding is not suitable for joint filling

SG 3.7 Concrete for Edge Restraints

3.7.1 Concrete supplied and placed for the construction of edge strips shall comply with the Specification for SG 7 CONCRETE WORKS.

3.7.2 Unless otherwise indicated on the Project Drawings, or where the edge restraint is provided by kerb and / or channel, the concrete used for edge restraints shall have a minimum 28-day characteristic compressive strength of 25MPa for edge restraints to pavers on road pavements and 20MPa for edge restraints to pavers on footpaths, bikeways, and medians.

Construction

SG 3.8 Paver Type, Shape, Class and Laying Pattern

3.8.1 The choice of concrete pavers shape type, shape name, colour, thickness and laying pattern shall be as shown on the Project Drawings for each area of application.

3.8.2 Council will require a minimum stock quantity for future replacements.

SG 3.9 Subgrade Preparation

3.9.1 For road pavements and areas subject to vehicle loads, the subgrade shall be trimmed and compacted to the required depth below finished surface level as shown on the approved Project Drawings and in accordance with Specification SG 2 ROAD PAVEMENTS.

3.9.2 Following completion of subgrade compaction and trimming, the whole of the subgrade area shall be inspected by proof rolling with a fully loaded single rear axle truck with a minimum axle load of 8 tonnes (or acceptable equivalent). Acceptable proof rolling shall be taken to be no visible signs of deformation or instability in the subgrade. [Hold Point]

3.9.3 For pedestrian and light traffic areas (i.e. footpaths, bikeways and medians) all soft, yielding or other unsuitable material shall be replaced with sound material and the subgrade shall be compacted to provide a minimum of 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. The subgrade shall be trimmed to be ± 30mm of the design subgrade level.

SG 3.10 Subbase/Base

3.10.1 Base course for pedestrian and light traffic areas (i.e. footpaths, bikeways, medians) shall be as shown on the Project Drawings, where not otherwise specified the base course shall be a 125mm thick compacted to 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. Base course material shall be minimum of Type 2.3 Pavement Material in accordance with the Specification for SG 2 ROAD PAVEMENTS.

3.10.2 For road pavements and areas subject to vehicle loads the subbase and base shall be constructed to the specified thickness and depth below finished surface level, and to the design grade and crossfalls of the finished surface, as shown on the approved Project Drawings in accordance with Specification SG 2 ROAD PAVEMENTS.

3.10.3 The base course shall extend in width to at least the rear face of all new edge restraints.

3.10.4 Notwithstanding the finished level tolerances contained within Specification SG 2 ROAD PAVEMENTS for base of ± 10mm of design levels, the level on the finished surface of the base course for road pavements to be overlain with segmental paving shall be trimmed to within + 10mm or - 0mm of design levels. The deviation from a 3m long straight edge placed anywhere and laid in any direction on the top surface of the base course for all segmental paving shall not exceed 10mm. Sand bedding material shall not be used as a levelling material to compensate for base finishing outside the above tolerances.

3.10.5 The finished surface of the base shall drain freely without ponding.

SG 3.11 Edge Restraints

3.11.1 Edge restraints in the form of kerb and / or channel or edge strips shall be constructed along the perimeter of all segmental paving as shown on the approved Project Drawings. Concrete kerb and / or channel and edge strips shall be constructed in accordance with specifications SG 2- ROAD PAVEMENTS and SG 7 CONCRETE WORKS

3.11.2 Faces of edge restraints abutting pavers shall be vertical.

3.11.3 Edge restraints shall be supported on compacted base and / or subbase of the thickness as shown on the approved Project Drawings. Where not otherwise specified or indicated, the minimum thickness of compacted base beneath the

edge restraints shall be 100mm adjacent to road pavements and medians, and 50mm adjacent to footpaths, bikeways and driveways.

3.11.4 Unless otherwise shown on the Project Drawings, expansion and contraction joints shall be provided in accordance with Specification SG 7 CONCRETE WORKS.

3.11.5 After the concrete has hardened and not earlier than three days after placing, the spaces at the back of the edge restraint shall be backfilled with earth, compacted in layers not greater than 150mm thick, then topsoiled to meet surrounding of design levels.

3.11.6 Hidden edge restraints may be used as an alternative for pedestrian and light traffic areas and shall be as detailed on the approved Project Drawings.

SG 3.12 Sand Bedding Course

3.12.1 The sand bedding course shall be spread in a single uniform layer and screeded in a loose condition to the nominated design profile and levels plus that necessary to achieve a uniformly thick nominal 25-35mm layer following final compaction of the segmental paving.

3.12.2 Any depressions in the screeding sand exceeding 5mm shall be loosened, raked and rescreeded before laying pavers.

3.12.3 Screeded sand left overnight if subject to rain shall be checked for level and rescreeded where necessary before pavers are placed. The sand shall not be screeded more than two metres in advance of the laying face at the completion of work on any day.

3.12.4 Drainage of the bedding course shall be as detailed on the approved Project Drawings.

SG 3.13 LAYING PAVERS

3.13.1 Unless otherwise specified, concrete pavers for road pavements shall be placed in herringbone laying pattern.

3.13.2 Pavers shall be uniformly placed on the screeded sand bedding to the nominated laying pattern. Pavers shall be placed so that they are not in direct contact with each other and shall have uniform 3mm nominal joint widths.

3.13.3 The first row shall be located next to an edge restraint or an established straight line, and laid at a suitable angle to achieve the required orientation of pavers in the completed pavement.

3.13.4 In each row, full units shall be laid first. Edge or closer units shall be neatly cut using a paver scour, or mechanical or hydraulic guillotine, and fitted subsequently. Cut pieces of pavers which are smaller in size than one quarter of a full block shall not be used.

3.13.5 Manholes, drainage gullies and similar penetrations through the pavement shall be finished against the paving with a concrete surround or apron designed to suit and fit the laying pattern, otherwise complying with the requirements for edge restraints.

3.13.6 Any foot or barrow traffic shall use boards overlaying paving to prevent disturbance of units prior to compaction. No other construction traffic shall be allowed on the pavement prior to compaction and provision of joint filling sand.

3.13.7 On completion of subsequent bedding compaction and joint filling operations, no more than 10 per cent of joints along any 10 metre line along a major axis of the laying pattern shall have widths outside the range of 2 - 4mm.

SG 3.14 Bedding Compaction

3.14.1 After laying the pavers, the sand bedding shall be fully compacted and the surface brought to design levels and surface profiles by not less than two passes of a high frequency low amplitude plate compactor, which covers at least 12 units. Compaction shall continue until lipping between adjoining units has been eliminated.

3.14.2 Any units which are structurally damaged during bedding compaction shall be removed and replaced. The pavement shall then be recompacted for at least one metre surrounding each replacement unit.

3.14.3 The paving operations shall be arranged so that the use of the plate compactor proceeds progressively behind the laying face without undue delay, and such that compaction is completed prior to cessation of construction activity on any day. Compaction shall not be attempted within one metre of the laying face except on completion of the pavement against an edge restraint.

3.14.4 The finished surface level shall not vary from the design level at any point laid in any direction, by more than 6mm for all road pavements and 8mm for all other areas of segmental paving. Notwithstanding this, the finished surface of the segmental paving, including where the paving abuts an edge restraint other than a drainage inlet, shall not deviate from the bottom of a 3m straight edge laid in any direction, except at grade changes, by more than 6mm for road pavements and 8mm for all other areas of segmental paving.

3.14.5 The abutting edges of two adjacent pavers should match, but in no circumstances should they differ by more than 2mm.

3.14.6 The surface level of pavers immediately adjacent to surface drainage channels shall finish not less than 5mm nor more than 10mm above the channel edge.

3.14.7 All compaction shall be complete and the pavement shall be brought to design profiles before spreading or placing sand filling in the joints.

SG 3.15 Filling Joints

3.15.1 As soon as practicable after bedding compaction, and in any case prior to termination of work on any day, dry sand for joint filling shall be spread over the pavement and the joints filled by brooming.

3.15.2 To ensure complete filling of the joints, both the filling sand and pavers shall be as dry as practicable when sand is spread and broomed into the joints.

3.15.3 The pavement shall then receive one or more passes of a plate compactor and the joints then refilled with sand, with the process then repeated sufficiently to ensure that the joints are completely filled.

SG 3.16 Protection of Work

3.16.1 Other than wheeled trolleys, forklifts and cluster-clamp vehicles, construction and other traffic shall not use the pavement until bedding compaction and joint filling operations have been completed.

SG 3.17 Opening to Traffic

3.17.1 As soon as practicable after the filling of joints, construction vehicles may use the pavement, and should be encouraged to traverse the greatest possible area of pavement to assist in the development of 'lock-up'.
3.17.2 Excess joint filling sand shall be removed prior to opening to traffic.
3.17.3 The pavement shall then be inspected by the Contractor at regular intervals up until the expiration of the Defects Liability Period to ensure that all joints remain completely filled.

SG 3.18 Tolerances

3.18.1 Where tolerances for individual components and associated dimensions are not specified on the Project Drawings, deviations from established lines, grades and dimensions in the completed work shall not exceed the values stated herein.
3.18.2 The dimensional tolerances as shown in Table S3.4

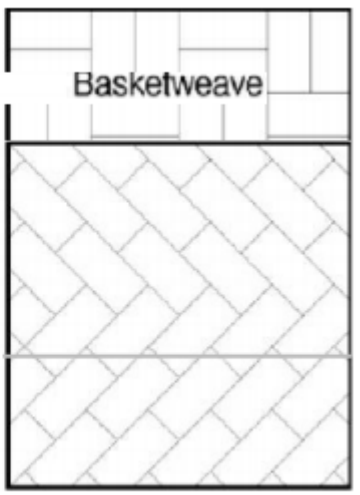
Table S3.4 Summary of Limits and Tolerances

Description	Limits/Tolerances
Base	Finished level of base for pavements to be within +10mm or -0mm of design levels.
	Finished level of base other than for road pavements, to be within +/10mm of design levels.
	Finished level of base other than for road pavements, to be within +/10mm of design levels
Segmental Paving Units (Joint Widths)	No more than 10% of joints along any 10 metre line of joints along a

	major axis of the laying pattern shall have widths outside the range 2 – 4mm.
Segmental Paving Units (Surface Level)	Finished surface level of pavers shall not vary from design levels by more than +/- 6mm for road pavements and +/- 8mm for other than road pavements.
	Finished surface of pavers shall not deviate from a 3m straight edge, laid in any direction, by more than 6mm for road pavements and 8mm for other road pavements.
	The abutting edges of two adjacent pavers shall not differ by more than 2mm.
	Finished surface level of pavers adjacent to surface drainage channels shall be no less than 5mm and no more than 10mm above the level of adjacent channel edge.

SG 3.19 Paver Laying Patterns

Stretcher



Zig Zag Running Bond

SG 4 Stormwater Drainage

General

SG 4.1 Scope

4.1.1 The specification details are all the requirements pertaining to the construction of stormwater drainage works.

4.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

SG 4.2 Reference Documents

4.2.1 Australian Standards

- 4.2.1.1 AS1597 Precast Reinforced Concrete Box Culverts
- 4.2.1.2 AS1650 Hot-Dipped Galvanised Coatings on Ferrous Articles
- 4.2.1.3 AS1761 Helical Lock-Seam Corrugated Steel Pipes
- 4.2.1.4 AS2338 Preferred Dimensions of Wrought Metal Products
- 4.2.1.5 AS2423 Galvanised Wire Fencing Products
- 4.2.1.6 AS3725 Loads on Buried Concrete Pipes
- 4.2.1.7 AS4058 Precast Concrete Pipes (pressure and non-pressure)
- 4.2.1.8 AS4159 Fibre-Reinforced Concrete Pipes and Fittings
- 4.2.1.9 AS5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications

4.2.2 All Australian Standards referenced in this specification shall be the current edition.

4.2.3 Department of Main Roads

- 4.2.3.1 MRS 11.03 Drainage, Retaining Structures and Protective Treatments

Materials

SG 4.3 Steel Reinforced Concrete Pipes (RCP)

4.3.1 Pipes shall conform in all respect to AS 4058.

4.3.2 Pipes up to and including 600mm diameter can be rubber ring jointed or flush with manufacturer's external bands; pipes larger than 600mm diameter shall be flush jointed with manufacturer's external bands.

4.3.3 In locations where the pipes are to be laid in a subgrade of sand or influenced by saltwater, rubber ringed joints shall be used.

4.3.4 Pipes laid in areas influenced by saltwater intrusion or acid sulphate soils, or where any part of the pipe is below the Highest Astronomical Tide the pipe will have cover to reinforcement in accordance with the exposure classification requirements of AS 3600.

4.3.5 The class of pipe shall be as specified or shown on the drawings. Minimum of Class "2".

SG 4.4 Fibre Reinforced Concrete Pipes (FRC)

4.4.1 Pipes shall conform to the AS 4139. Pipes of the same diameter and class can be used in lieu of Steel Reinforced Concrete Pipes.

4.4.2 In locations where the pipes are to be laid in a subgrade of sand or influenced by saltwater, rubber ringed joints shall be used.

4.4.3 Where rubber ring joints are specified the "V" section rubber ring shall be used and are to be jointed using the manufacturer's lubricant.

SG 4.5 Reinforced Concrete Box Culverts (RCBC)

4.5.1 Box culverts shall be of the "Inverted U" type unless specified otherwise and shall conform in all respects to the current edition of AS 1597.

4.5.2 Box culverts laid in areas influenced by saltwater intrusion or acid sulphate soils, or where any part of the pipe is below the Highest Astronomical Tide the box culvert will have cover to reinforcement in accordance with the exposure classification requirements of AS 3600.

SG 4.7 Polypropylene Pipes

4.7.1 Pipes shall conform to the AS 5065. Pipes shall only be used within allotments with the prior approval of Council. “As Constructed” drawings shall clearly indicate location of polypropylene pipes. Polypropylene pipes shall not be used within road reserves.

SG 4.8 Bedding Materials

4.8.1 Concrete and Fibre Reinforced Concrete Pipes:

4.8.1.1 Bedding shall consist of clean coarse sand with 100% passing the 19mm AS Sieve and not more than 15% passing the 0.075mm AS Sieve.

4.8.2 Reinforced Concrete Box Culverts:

4.8.2.1 The bedding material to be used in conjunction with box culverts should conform to the grading specified in the Main Roads Standard Specification MRS11.03.

SG 4.9 Steel Wire Gabion and Mattress Protection Works

4.9.1 Steel wire gabions and mattresses shall be proprietary products manufactured from heavily galvanised hexagonally woven steel-wire mesh and filled with rock conforming to the material requirement specified in Main Roads Specification MRS 11.03.

SG 4.10 Concrete

4.10.1 The concrete and reinforcement used in the construction of gully pits, manholes, headwalls and aprons etc shall comply with Specification SG 7 CONCRETE WORKS.

SG 4.11 Manhole Covers and Frames

4.11.1 Cast iron covers and frames are to be supplied for all stormwater manholes and shall be manufactured and tested in accordance with AS 3996.

4.11.2 All openings shall conform to the details on Council's Standard Drawing

4.11.3 All covers shall have a raised stud pattern with the letters SW (65mm high) cast into the centre of the lid and "gatic" type lifting holes.

4.11.4 Minimum classes of manhole covers shall be as follows:

4.11.4.1 Within Residential Properties and Parks - Class B

4.11.4.2 Residential Road Reserves:

4.11.4.2.1 Up to collector street status - Class C

4.11.4.2.2 Trunk Collector or higher - Class D

4.11.4.3 Industrial, Commercial Road Reserves - Class D

SG 4.12 Grates and Frames

4.12.1 Grates and frames of gully pits are to be fabricated from grade 250 steel and shall comply with the requirements of AS 3996 They shall be constructed to the dimensions and details supplied on the Council's Standard Drawing and shall be Hot Dipped Galvanised to the requirements of AS 1650.

4.12.2 Grates for structures other than gully pits shall be bicycle safe, and of a classification applicable to its location in accordance with AS 3996.

SG 4.13 Floodgates

4.13.1 Floodgates shall be a proprietary product manufactured from non-corrosive material of a type specified on the approved Project Drawings.

SG 4.14 Backfill Material

4.14.1 Backfill material shall generally be selected fill material, not markedly different in character from the surrounding soil, free from large stones, lumps of clay, topsoil, tree roots and other rubbish. It shall have an even grading free of lumps retained on a 75mm sieve and free of stones retained on a 25mm sieve.

4.14.2 Stabilised Backfill material may need to be required when utilising Corrugated Aluminium Alloy Pipes. Where such materials are required, only approved mixes in accordance with the manufacturers recommendations shall be accepted.

Construction

SG 4.15 Setout

4.15.1 The alignment of the stormwater pipes and position of the gully pits, manholes and headwalls shall be as stated in the approved Project Drawings and set out from a datum line established by a Registered Surveyor. The datum line may be either the road centreline, property boundary, a pegged chainage offset line, or any alternative datum suitable for the purposes of accurately setting out the works.

4.15.2 The invert levels of the pipes shall be maintained in strict accordance with site bench marks and only approved and tested equipment shall be used to establish and maintain these levels.

SG 4.16 Clearing & Grubbing

4.16.1 All clearing and grubbing works shall be in accordance with Specification SG 1 EARTHWORKS.

4.16.2 Where stormwater lines pass through allotments any trees or obstructions not on the line of the pipes shall be preserved.

SG 4.17 Trenching

4.17.1 All trenching and foundation works necessary for the installation of stormwater drainage works, shall be in accordance with Specification SG 1 EARTHWORKS.

4.17.2 Trench or foundation excavation for stormwater drainage works shall be undertaken to the planned level for the bottom of the specified bedding or foundation level. All loose material shall be removed from the bottom of the trench.

4.17.3 The width of trenching excavation shall be in accordance with the Council Standard Drawings, the trench base and comply with all regulations of Workplace Health and Safety Act.

4.17.4 In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

4.17.5 Where public utilities exist in the vicinity of stormwater drainage works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.

SG 4.18 Diverting Water and Dewatering

4.18.1 During construction all care should be taken to ensure any water, which may interfere with the progress of the works, be diverted to keep the trenches and excavations free from water so as to prevent any damage to the works due to flooding or other causes.

4.18.2 The necessary pumping items shall be kept on hand to ensure the excavation is constantly dewatered during the progress of the works.

4.18.3 Discharge for dewatering pumps shall be directed to location approved by and to the satisfaction of Council.

4.18.4 Care shall be taken to ensure that discharge flows do not cause any flooding, erosion or environmental harm, where necessary appropriate measure shall be put in place to trap and dispose of entrained sediments.

4.18.5 In areas where acid sulphate soils are present, discharge flows shall be disposed of and/or treated in accordance with an approved acid sulphates soils management plan.

SG 4.19 Bedding

General

4.19.1 Pipe support and bedding shall be in accordance with AS 3725 for pipe support types shown on the approved Project Drawings. Where the pipe support type is not shown on the Drawings, the minimum pipe support type shall be HS2 within road reserves and H1 elsewhere.

4.19.2 The bedding and haunch zone material shall be placed and compacted in accordance with AS 3725, with care be taken around the Haunch zone area to avoid disturbing the position of the pipe. The surface of every pipe should have full and even contact with the bedding material.

4.19.3 In trenches with bad ground water conditions and/or unsuitable material the trench should be over excavated to allow a foundation layer of crushed rock material (min. depth 250mm) to be placed to provide an adequate foundation. A geofabric to engineering design should be placed for the full width of the trench and overlapped 450mm prior to placing the bedding material and laying the pipes in this instance.

Box Culverts

4.19.4 Bedding for precast and cast insitu base slabs shall be selected backfill to a compacted depth of 150mm laid to the line and level of the underside of the base slab. The bedding shall be finished to a smooth surface with a tolerance of ± 10mm in level and ± 50mm in line.

SG 4.20 Lay and Joint Pipes

Concrete and Fibre Reinforced Concrete Pipes

4.20.1 Pipe laying shall begin at the downstream end of the line with the socket or grooved end of the pipe facing upstream. When the pipes are laid, the barrel of each pipe shall be in contact with the bedding material throughout its full length.

4.20.2 When elliptical pipes with circular reinforcement or circular pipes with elliptical reinforcement are used, the pipes shall be laid in such a position that the manufacturer's marks, designating the "Top" or "Bottom" of the pipe shall not be more than 5 degrees from a vertical plane through the longitudinal axis of the pipe.

4.20.3 External joints shall be taped with the manufacturers supplied tape or rubber external sand bands upon final bedding and alignment.

4.20.4 Lifting holes in pipes shall be plugged with mortar, precast tapered concrete / plastic plugs, or other approved means prior to backfill material being placed.

4.20.5 Joints shall not be made under water. The trench must be de-watered to facilitate joint making and inspection. Precautions must be taken to prevent erosion of joint material by moving currents of water.

4.20.6 Drainage lines shall be constructed with a tolerance of ± 15mm in line or level over any section 30m in length (providing each pipe unit has a fall in the direction of flow) from the alignment and levels shown on the approved Project Drawings.

Reinforced Concrete Box Culverts

4.20.7 The base of the box culvert shall be laid true to line and grade before the crown units of the box culvert segments are laid.

4.20.8 All construction methods, tolerances and requirements for box culverts shall conform to the requirements detailed in Main Roads Standard Specification MRS 11.03.

SG 4.21 Backfill

Concrete & Reinforced Pipes

4.21.1 Compaction standards for backfill material shall conform to Table S4.1.

Table S4.1 Backfill Compaction

Location	Minimum Dry Density (Cohesive soils)	Minimum Density Index (Cohensionless soils)
Under Road embankments: **>0.3m below pavement subgrade** **<0.3m below pavement subgrade**	 95% Standard 98% Standard	 65% 80%
Elsewhere	95% Standard	65%

Note: Compaction requirements are with reference to the relevant Test Methods Contained in AS 1289.

4.21.2 For trench installations, mechanical compacters shall be used. Where impact tampers are used caution must be exercised not to allow a direct blow on the pipe. The material should be compacted at near optimum moisture content and should be brought up evenly in layers not exceeding 150mm on both sides of

the pipe up to 150mm over the pipe. It should not be bulldozed into the trench nor dropped directly on the pipe.

4.21.3 Heavy mechanical equipment must not be used for tamping of backfill or be permitted to run over pipelines at shallow depths except at prepared crossing places and where approved.

4.21.4 For trenches not contained within the road reserve the trench shall be refilled to natural surface level with fill material placed evenly in 150mm to 300mm layers, tamped thoroughly.

4.21.5 The backfilling should be completed as soon as possible after pipe laying, and before the pipeline is charged with water. This will avoid the risk of pipes floating if the trench becomes flooded.

SG 4.22 Drainage Structures

4.22.1 Gullies, manholes and field inlets shall be constructed to the form and dimensions shown on the plans and in accordance with Council's Standard Drawings. Where the ground is solid, back forms need not be used in the construction of drainage structures, the concrete being poured against the earth. Where this is done, the thickness of the wall of such gully or manhole shall be increased to a minimum of 50mm greater than the dimension shown on the plan.

4.22.2 The joints between drainage structures and pipes shall be made watertight using cement mortar. The mortar shall be used within one hour of mixing and shall not be retempered. The joints shall be finished to provide smooth surfaces, uniform with the inner surfaces of the structure.

4.22.3 Concrete benching shall be shaped as specified and shall have smooth, even surfaces and neat edges. Step irons shall be installed horizontal, vertically in line, and shall project uniformly from the walls, where the depth of the structure is greater than 1.5m.

4.22.4 Where step irons are not cast-in-place, they shall be epoxy mortared into drilled holes. The joints between the step irons and the walls shall be completely filled so that the step irons are held rigid and the joints are watertight.

4.22.5 Concrete top slabs in Manholes shall be joined to the walls using cement mortar or epoxy mortar. The opening in the top slab shall be closed with temporary covers, after which excavations shall be backfilled. Cast in situ concrete surrounds shall be constructed on the top slabs to encase the frames. Alternatively, precast concrete surrounds may be employed, using epoxy mortared joints. Only approved covers in accordance with this Specification shall be installed in the frames.

4.22.6 Temporary covers to Gullies and Manholes may remain in position and installation of the frames and surrounds deferred until pavement construction has reached a stage where the frames and surrounds can be positioned accurately. Where construction is in a staged format, the joint between each pour shall be suitably roughened to ensure an adequate bind and seal is achieved between the successive concrete pours.

4.22.7 Compaction of material surrounding drainage structures shall be in accordance with Table S4.1.

SG 4.23 Steel Wire Gabions and Mattress Protection

4.23.1 These proprietary products shall be assembled and installed in accordance with the Main Roads Standard Specification MRS 11.03.

SG 4.24 Headwalls, Wingwalls and Aprons

Cast Insitu

4.24.1 Where necessary, localised excavations shall be carried out to allow construction of cast insitu end structures.

4.24.2 Cast insitu endwalls, wingwalls and aprons, shall be constructed to the dimensions and other requirements shown on the approved Project Drawings and in accordance with Council's Standard Drawings.

4.24.3 Concrete work shall comply with Specification SG 7 CONCRETE WORKS. Construction of endwalls and wingwalls shall include the construction of integral cut-off walls, where required.

Precast

4.24.4 Where necessary, localised excavations shall be carried out to allow installation of precast concrete end structures.

4.24.5 End structures shall be laid on foundation bedding, which provides continuous even support to the structures. Foundation bedding material shall be compacted to the relevant standard specified below:

4.24.5.1 Cohesive material - to not less than 95% Standard Compaction. ☐ Non-cohesive material - to a density index of not less than 65.

4.24.5.2 The joints between end structures and culverts shall be filled with cement mortar. The joint areas shall be thoroughly cleaned and wetted just prior to filling. All points shall be finished smooth and uniform with the surfaces of the end structures.

4.24.6 Any holes and recesses provided in end structures to assist installation shall be neatly plugged or filled with cement mortar.

4.24.7 Mortared joints and filled holes and recesses shall be cured for a period of not less than 48 hours. Backfill operations against end structures shall not be carried out during this curing period.

SG 4.25 Floodgates

4.25.1 Floodgates can be sleeved over the end of the pipe, secured with stainless steel bands or fixed to with a flange to headwalls. Installation shall be in accordance with the manufacturers recommendations.

SG 4.26 Tolerances

4.26.1 Tolerances for the construction of Stormwater Drainage Works shall comply with Table S4.2.

Table 4.2 Construction Tolerances

Location	Tolerance
Invert Levels	+10mm -10mm
Surface Levels	+50mm - 50mm in Allotments +10mm - 10mm in Roadways
Structure Locations	Within 100mm of design in Allotments or Park Within 50mm of design longitudinally along roadway Within 10mm of design at right angles to road
Crest of Spillway and Detention Basins	Trimmed to +25mm - 10mm

SG 5 – Water Reticulation

General

SG 5.1 Scope

5.1.1 This specification details all matters pertaining to Water Supply Reticulation Construction.

5.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

5.1.3 Aspects of modification or clarification of the Water Supply Code of Australia WSA 03 – 2002 are detailed in Appendix A of Design Guideline – D6.

5.1.4 Aspects of modification or clarification of the Water Supply Code of Australia WSA 03 – 2002 – Water Supply Code of Australia – Standard Drawings are detailed in Appendix A of this document.

SG 5.2 Reference Documents

5.2.1 Australian Standards:

- 5.2.1.1 AS1289 Methods of Testing Soils for Engineering Purposes
- 5.2.1.2 AS1432 Copper Tubes for Plumbing, Gasfitting and Drainage Applications
- 5.2.1.3 AS/NZS1477 PVC Pipes and Fittings for Pressure Applications
- 5.2.1.4 AS1646 Elastomatic Seals for Waterworks Purposed
- 5.2.1.5 AS/NZS1906 Retroreflective Material and Devices for Road Traffic Control Purposes
- 5.2.1.6 AS2032 Code of Practice for Installation of PVC Pipe Systems
- 5.2.1.7 AS2033 Installation of Polyethylene Pipe Systems
- 5.2.1.8 AS2129 Flanges for Pipes, Valves and Fittings
- 5.2.1.9 AS/NZS2280 Ductile Iron Pressure Pipes and Fittings
- 5.2.1.10 AS2638 Sluice Values for Waterworks Purposes
- 5.2.1.11 AS3500 National Plumbing and Drainage Code
- 5.2.1.12 AS3952 Water Supply – DN80 Spring Hydrant Valve for General Purposes
- 5.2.1.13 AS/NZS4129 Fittings for Plyethylene (PE) Pipes for Pressure Applications
- 5.2.1.14 AS/NZS4130 Polyethylene (PE) Pipes for Pressure Applications
- 5.2.1.15 AS4441 Oriented PVC (PVC-O) Pipes for Pressure Applications
- 5.2.1.16 AS/NZS4765 Modified PVC (PVC-M) Pipe for Pressure Applications

5.2.2 Department of Main Roads

- 5.2.2.1 MRS 11.45 Pavement Marking

5.2.3 Water Services Association of Australia

5.2.4 WSA 03 – Water Supply Code of Australia

Materials

SG 5.3 Pipes General

5.3.1 All pipes used for water main reticulation shall be constructed from the following materials:
- 5.3.1.1 Polyvinylchloride (PVC)
- 5.3.1.2 Polyethylene (PE); or
- 5.3.1.3 Ductile Iron.

SG 5.4 Unplacticised PVC (PVC-U)

5.4.1 Unplasticised PVC (PVC-U) pipes shall be manufactured in accordance with AS/NZS 1477 by an Australian Standards quality endorsed company.

5.4.2 Modified PVC (PVC-M) pipes manufactured in accordance with AS/NZS 4765 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U.

5.4.3 Oriented PVC (PVC-O) pipes manufactured in accordance with AS 4441 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U

5.4.4 PVC pipes 100mm diameter and greater to be Class 16 rubber ring jointed (Ductile iron O.D compatible).

5.4.5 Rubber Rings shall be manufactured and tested in accordance with AS 1646. Jointing lubricant in accordance with the manufacturers' specification should be used to facilitate jointing.

SG 5.5 Polyethylene Pipe

5.5.1 Polyethylene pipe shall be manufactured in accordance with AS/NZS 4130 by an Australian Standards quality endorsed company.

5.5.2 PE pipes up to 50mm inside diameter to be Class 16

5.5.3 Fittings shall comply with AS/NZS 4129.

SG 5.6 Ductile Iron

5.6.1 Ductile Iron pipes shall be manufactured and cement lined in accordance with AS/NZS 2280 by an Australian Standards quality endorsed company.

5.6.2 Socketed pipes to be Class K9 suitable for the patented "Tyton" type rubber ring joint. Flanged pipes to be Class K12.

5.6.3 Flanges shall comply with AS 2129 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129.

5.6.4 All pipes and fittings shall be wrapped in a loose polyethylene sleeving 0.25mm thick. Wrapping and taping shall be carried out in accordance with the pipe manufactures recommendations.

SG 5.7 Bedding Material

5.7.1 Bedding Material shall consist of a clean coarse sand free from organic matter, clay, shells and deleterious material with 100% passing the 6.7mm AS sieve and not more than 5% passing a 0.150mm AS sieve.

SG 5.8 Valves

5.8.1 All Valves shall be manufactured in accordance with AS 2638 by an Australian Standards quality endorsed company.

5.8.2 Valves of 80mm diameter and larger, are to be coated with a thermosetting epoxy powder to AS 2638 and AS 3952.

5.8.3 All 50mm diameter valves shall be DR brass construction with appropriate pressure rating or approved equivalent and certified by QAS to Standards Mark or Water Mark. All valves shall be fitted with bronze tee handles.

5.8.4 All valves 80mm and greater to be anti clockwise to close.

SG 5.9 Hydrants

5.9.1 Hydrants shall be the spring hydrant "Maxi Flow" 2000 type (DN80) manufactured in accordance with AS 3952 by an Australian Standards quality endorsed company. Hydrants are to be coated with a thermosetting epoxy powder to AS 2638 and AS 3952.

SG 5.10 Bends and Tees

5.10.1 All bends for mains of 80mm diameter or larger and all other associated fittings shall be constructed in accordance with AS/NZS 2280, and have flanged or spigot and socket type joints as specified on the approved Project Drawings. Where flanges are used, bolts shall be matched sets and conform to the following criteria:

5.10.2 In above ground uses, bolts shall be Hot Dipped Galvanised □In below ground uses, bolts shall be Grade 316 Stainless Steel with nuts and washers Grade 304 stainless steel.

5.10.3 All bends, tees and miscellaneous fittings shall be factory nylon powder coated unless otherwise specified.

SG 5.11 Pavement Marking

5.11.1 The manufacture, supply and material requirements appropriate to the specification of pavement marking shall be in accordance with Main Roads Standard Specification "MRS11.45 Pavement Marking".

SG 5.12 Raised Retro Reflective Marking

5.12.1 Raised retroreflective pavement markers used to locate hydrants shall be blue bi directional markers.

5.12.2 The material requirements of the raised retroreflective pavement markers shall be in accordance with Main Roads Standard Specification "MRS11.45 Pavement Marking".

SG 5.13 Setout

5.13.1 The location and sizes of the mains and position of valves and hydrants shall be as stated on the approved Project Drawings.

5.13.2 Bends shall be positioned such that the correct alignment is maintained and remains within the allotted service corridor.

5.13.3 Where levels are nominated on the approved Project Drawings the Contractor shall ensure the main is laid within the given tolerances and the equipment used to level the main is approved and tested.

5.13.4 Alignment of the water main shall be 2.500m off the property boundary, with horizontal centreline deviations permissible provided the main remains entirely within the 450 mm wide footpath allocation.

5.13.5 Deflection of water mains is not allowed. Bends are to be used for change of direction.

5.13.6 Where a hydrant is placed at the end of a water main which will not be extended in the future, e.g., in cul-de-sac; the hydrant shall be installed with a hydrant bend located adjacent to the boundary of the last property serviced.

5.13.7 In cases where the main may be extended in the future, a hydrant tee and dead end shall be used, located as near as practicable (<0.5m) to the development boundary or nearest RP boundary.

5.13.8 The maximum spacing of hydrants shall be 80m with hydrants located at all crests, sags and ends of lines in cul-de-sacs.

5.13.9 Spring hydrants are to be oriented with bolts parallel to the water main.

SG 5.14 Clearing and Grubbing

5.14.1 All trenching and foundation works necessary for the installation of the pipeline or thrust blocks, shall be in accordance with Specification SG 1 EARTHWORKS.

5.14.2 The width of trenching excavation shall be in accordance with the Council's Standard Drawing at the trench base and comply with all regulations of Workplace Health and Safety Act.

5.14.3 In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

5.14.4 Where public utilities exist in the vicinity of water main drainage works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.

5.14.5 The safety of the public shall be considered at all times. Where necessary, fenced walkways and controlled vehicular crossways shall be provided across trenches to maintain access from carriageway to individual properties or within individual properties. All such installations shall be of adequate size and strength and satisfactorily illuminated.

5.14.6 In the event of any trenching being left open for longer than one week, the Contractor shall provide erosion control measures to ensure minimal soil disturbance and material loss off the site. Some or all of these measures shall be provided immediately upon the onset of rain with an open trench.

5.14.7 The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of spoil banks. No excavated materials shall be stacked against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be kept separate and utilised to make good the surface after backfilling.

SG 5.15 Trenching

5.15.1 All trenching and foundation works necessary for the installation of the pipeline or thrust blocks, shall be in accordance with Specification SG 1 EARTHWORKS.

5.15.2 The width of trenching excavation shall be in accordance with the Council's Standard Drawing at the trench base and comply with all regulations of Workplace Health and Safety Act.

5.15.3 In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

5.15.4 Where public utilities exist in the vicinity of water main drainage works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.

5.15.5 The safety of the public shall be considered at all times. Where necessary, fenced walkways and controlled vehicular crossways shall be provided across trenches to maintain access from carriageway to individual properties or within individual properties. All such installations shall be of adequate size and strength and satisfactorily illuminated.

5.15.6 In the event of any trenching being left open for longer than one week, the Contractor shall provide erosion control measures to ensure minimal soil disturbance and material loss off the site. Some or all of these measures shall be provided immediately upon the onset of rain with an open trench.

5.15.7 The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of spoil banks. No excavated materials shall be stacked against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be kept separate and utilised to make good the surface after backfilling.

SG 5.16 Cover

5.16.1 Unless noted otherwise on the approved Project Drawings the minimum depth of cover to be provided for mains shall be as follows:

5.16.1.1 For mains of 100mm and 150mm diameter: minimum 600mm - maximum 750mm, in a verge or roadway; measured from the top of pipe to the adjacent top of kerb.

5.16.1.2 For 225mm and 300mm diameter: minimum 700mm, maximum 850mm

5.16.1.3 For mains greater that 225 mm diameter, individual assessment dependent upon valve height shall be determined by the Engineer.

5.16.1.4 Where normal cover for mains is unable to be maintained due to the presence of existing services or other restricting factors ductile iron pipe, may be used, subject to the approval of the Engineer.

5.16.1.5 Main shall not be laid under stormwater, sewerage pipes or electricity conduits unless approved by the Engineer.

SG 5.17 Crossings

Major Road Crossings

5.17.1 Written approval from the Queensland Department of Transport is required if a main is to be constructed underneath or along a declared Main Road.

5.17.2 All road crossings shall have an enveloper pipe and the main shall be grouted in the enveloper pipe.

5.17.3 The design and construction of the enveloping conduit must be in accordance with Queensland Department of Transport's "Installation of Underground Conduits within the Boundaries of Declared Roads".

Crossings of Other Existing Roads and Streets

5.17.4 Unless otherwise approved in writing, all crossings of existing roads and streets shall be bored or jacked with no disturbance to the pavement, shoulders or kerb.

5.17.5 The Engineer may permit open trenching to streets below Collector, determined by the location, traffic conditions and age of the existing pavement.

5.17.6 The details of the crossing, pipe materials and grouting shall be submitted to Council for approval.

5.17.7 Crossings of other carriageways shall be trenched unless the Engineer specifies otherwise.

Railway Crossings

5.17.8 Written approval from the Queensland Rail is required if a main is to be constructed underneath a railway line. In such cases the crossing shall generally be designed and constructed in accordance with the requirements of Queensland Rail.

SG 5.18 Bedding

5.18.1 All pipes shall be uniformly bedded in order to ensure solid and uniform support for the full length of the barrel with bell holes formed to accommodate the sockets to ensure a minimum clearance of 20mm.

5.18.2 The depth of bedding shall be as detailed on Council's Standard Drawing with the bedding material complying with the "Bedding Material" section of this Specification.

SG 5.19 Laying and Jointing of Pipes

5.19.1 All contractors shall have undertaken a manufacturers pipe laying accreditation course.

5.19.2 All pipe lines shall be laid to such lines, offset, gradients and levels as shown on approved Project Drawings.

5.19.3 Care shall be taken to preserve uniform gradients and correct alignments. Bends shall be used to effect horizontal and vertical changes of direction.

5.19.4 The manufacturers' recommendations for maximum deflection at each joint shall be strictly adhered to, if approval is granted by Council to use deflections.

5.19.5 Jointing of pipes, valves and fittings is to be carried out to the manufactures recommendations and in accordance with Australian Standards where applicable.

5.19.6 For pipes with rubber ring joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. When the joint is made, the witness mark shall at no point be more than 1mm from the end of the socket.

5.19.7 Before being laid, all pipes, fittings, valves, etc shall be cleaned and examined by the Contractor.

5.19.8 Approved plugs shall be used to prevent foreign matter entering sections of pipeline, which are left uncompleted overnight.

5.19.9 The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

5.19.10 Pipes shall be cut as needed to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

5.19.11 For field cuts, only an approved mechanical pipe cutter shall be used, except that uPVC pipes may be cut using a power saw or a fine toothed hand saw and mitre box.

5.19.12 Any pipes cut in the field shall have their ends prepared in accordance with the manufacturer's written instructions.

5.19.13 Where pipes are cut in the field, a witness mark shall be made on the pipe at the length specified by the manufacturer from the end of the pipe. Scoring of uPVC pipes shall not be permitted.

SG 5.20 Connection to Existing Mains

5.20.1 Ready tap, or equivalent, connection points shall be laid with the main within 300 mm of the side property boundaries.

5.20.2 The Ready tap connection point is to be installed with a valve on one side and a bung on the other.

SG 5.21 Fittings

5.21.1 The laying and jointing of mains shall include the fixing in position of all valves of any description, fire hydrants and all other fittings, which are necessary for the completion of the mains.

5.21.2 Joints to secure fittings to pipes shall be approved under Australian Standard AS1646.

5.21.3 All sluice valves, gate valves, air valves and hydrants shall be carefully placed in the final position so as to be the correct distance from the surface and installed in accordance with Council's Standard Drawings. With air valves and hydrants, risers shall be installed where necessary and if required, trenches

shall be deepened and graded in the vicinity of all valves and hydrants in order to secure the correct depth below the surface.

5.21.4 Valves, hydrants and specials shall be thoroughly cleaned out prior to installation in main.

5.21.5 The spring hydrants shall be bolted to the flange of the hydrant junction so that the bolts of the hydrants are in line with the main, and the hydrant cover box fitted with its long axis along the centre line of the main. Hydrants must be protected during backfilling in such a manner as will prevent earth or grit from damaging the seating. Refer to Council's standard drawing.

5.21.6 Hydrants and valves shall be fully protected during laying and backfilling, on completion all glands shall be well screwed down, and all valves shall operate freely.

SG 5.22 Valve/Hydrant Markers

5.22.1 The position of all stop valve, scour valve, air valve and hydrants shall be indicated by a kerb marker plate, painted kerb marker or marker post and raised reflective pavement markers. The type of marker to be installed shall be as stated on the approved Project Drawings.

5.22.2 Painted symbols used to indicated hydrants shall be in accordance with Council's Standard Drawing.

5.22.3 Kerb marker plates used to indicate valve and hydrant locations shall be fixed to the kerb face it shall be in accordance with Council's Standard Drawing.

5.22.4 Kerb and channel shall be stamped or engraved, and posts with marker notice plates are to be located adjacent to each valve, hydrant, air valve and scour valve. The posts are to be located 0.3m on the kerbside of the property alignment unless otherwise directed by the Engineer.

5.22.5 Kerb stamping or engraving, and marker plates shall be marked "V", "H", "AV" and "S" indicating sluice valve, hydrant, air valve and scour valve respectively shall be installed on the posts.

5.22.6 In addition to painted kerb markers / marker posts, all hydrants shall have a road pavement marker to indicate the location of the hydrant. The road pavement marker shall be either a painted teardrop or blue bi directional raised retro reflective pavement marker as stated on the approved Project Drawings.

5.22.7 Where a painted teardrop is specified the teardrop shall be painted with a solid yellow enamel paint and be 630mm overall length with 200mm radius base and a 25mm radius tip. The teardrop shall be painted across the centreline of a two-lane road or in the middle of the near side lane of a multi laned road. The tapered end of the teardrop shall point towards the relevant hydrant

5.22.8 Where a blue bi-directional raised retro reflective pavement marker is specified it shall be fixed securely to the road pavement opposite the hydrant. On two lane roads, the marker is to be positioned on the road centreline. For multi-lane roads, it is to be positioned on the lane line between the first and second lane.

5.22.9 The installation requirements of and pavement makings and raised retroreflective pavement markers shall be in accordance with Main Roads Standard Specification "MRS11.45 Pavement Marking".

SG 5.23 Anchor Blocks

5.23.1 Where a main is installed at a grade of 1 in 6 or steeper, concrete anchor blocks shall be provided in accordance with Council's Standard Drawing
5.23.2 Concrete works shall comply with Specification SG 7 CONCRETE WORKS.

SG 5.24 THRUST BLOCKS

5.24.1 For vertical bends with an upward thrust additional concrete shall be placed so that the mass of concrete is greater than the thrust on the filling. Sufficient steel reinforcement shall be included to bend the weight of the block below the pipe centreline to the upper part of the block. These thrust blocks shall be designed to manufacturer's specifications.
5.24.2 Thrust blocks, sized in accordance with the requirements of the Manufactures specifications.
5.24.3 Concrete works shall comply with Specification SG 7 CONCRETE WORKS

SG 5.25 Water Service Connections

5.25.1 Connection points shall be laid within 300 mm of the side property boundaries and a maximum of 300mm inside the property boundary.
5.25.2 The connection point is to be installed in accordance with Council's Standard Drawings.
5.25.3 All services shall be turned on during the testing process.
5.25.4 Water service pipe riser material must be Copper (Northern Region) & Stainless Steel (Southern Region).

SG 5.26 Backfilling and Compaction

5.26.1 Material for the side support and overlay of the pipe shall comply with the pipe bedding material specification. The material shall be compacted in layers of not more than 150mm to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289.
5.26.2 The remainder of the excavation shall be backfilled with excavated material. The backfill shall be compacted in layers of not more than 150mm thick to 95 per cent of the standard. maximum dry density of the material used when

determined in accordance with AS1289. Flooding of cohesive material shall not be permitted as a means of compacting backfill.

5.26.3 Backfilling and compaction shall be carried out without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

5.26.4 The edges of the trench shall be cut with a clean, straight line prior to excavation. The trench above the approved filling shall be backfilled with approved subgrade replacement material conforming to Table D3.2 Minimum Pavement Design Criteria, to a level 280 mm below the level of the existing pavement surface, 150 mm and 100 mm separate layers of 1.5% and 3.0% cement stabilised road base Type 2.1 and Type 2.3 shall be compacted over the excavated fill layer, both compacted to 95% relative dry density as determined by Test 5.1.1 of AS 1289 (Standard Compaction), and 30 mm of asphaltic concrete shall be used to compete the trench backfilling. The road shall be restored to a minimum standard stated above or equal to the original standard which ever is greater.

5.26.5 Backfill material down to a depth of 300mm below the underside of the pavement material shall be compacted to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289, and backfill material below such depth shall be compacted to not less than 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289.

5.26.6 In cases other than those covered by the above clause backfilling above the level of 300mm above the top of the pipes in open trenches may be carried out by dumping from mechanical plant into the trench providing that no rock is placed in the trench until the pipes are covered by at least 300mm of soil backfill.

5.26.7 Compaction testing shall be carried out at a rate of 1 test for each 150 metres of trench backfilled or in the case where trenches are constructed under road pavements and road shoulders, 1 test for each 25 metres of trench backfilled.

SG 5.27 Restoration of Surfaces

5.27.1 Pavements, lawns and other improved areas shall be cleaned and left in the same order as they were at the commencement of the works. Lawns shall be restored with turf cut and set aside from the original surface and / or with imported turf.

5.27.2 All restored surfaces shall be maintained in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces. Pavements shall be maintained with crushed metal, gravel or other suitable material allowing for consolidation and shall then be restored to a condition equivalent to that of the original pavement.

5.27.3 Immediately the backfilling of a trench excavated through a pavement has been completed, the pavement shall be temporarily restored. Where the trench crosses bitumen or concrete pavement, a pre-mixed asphaltic material shall be

used for such temporary restoration. Temporary restoration works shall be maintained by the Contractor until final restoration is carried out.

5.27.4 Final restoration of the pavement shall be carried out to restore the pavement and its subbase to no less than the original condition. Unless noted otherwise on the approved Project Drawings all trenches excavated through bitumen or concrete pavement shall be sawcut each side to facilitate a neat finish to the final restoration. Final restoration may include, if required, the removal of temporary restoration.

5.27.5 Backfill shall be placed sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor.

5.27.6 In locations where surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench in such a way as to minimise future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the end of the Defects Liability Period.

5.27.7 Where, within public or private property, the reasonable convenience of persons will require such, trenches to be levelled off at the time of backfilling. Any subsequent settlement shall be made good by the Contractor, as required by placing additional fill.

5.27.8 All tunnels shall be completely backfilled. The space between the outer surface of the pipes, internal lining and the fact of the tunnel excavation shall be backfilled with sand which shall be compacted by flooding. Sand used for backfilling shall comply with the grading requirements for bedding sand as hereinbefore specified.

5.27.9 The Superintendent may direct the Contractor to backfill the tunnel with Grade N20 concrete in lieu of sand.

SG 5.28 Testing of Lines

5.28.1 Hydrostatic pressure testing of all water mains shall be carried out prior to the acceptance of the works and witnessed by the consulting Engineer and a council officer.

5.28.2 The contractor shall have carried out a successful test prior to arranging a Council witness test.

5.28.3 Pressure testing shall not be carried out during wet weather unless otherwise approved by Council.

5.28.4 Before testing a pipeline section, it shall be cleaned and filled slowly with water, taking care that all air is expelled.

5.28.5 The minimum test pressure acceptable shall be 1200 KPa unless advised otherwise by the relevant Local Authority and shall be considered to be satisfactory if:

5.28.5.1 There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
5.28.5.2 There is no visible leakage; and
5.28.5.3 There is no loss of pressure in the 24 hour test period outside of the parameters allowed for under AS2566.2, Constant Pressure Method.

5.28.6 The specified test pressure shall be maintained as long as required, while the whole section is examined, and in any case not less than 24 hours.

5.28.7 Any failure, defect, and / or visible leakage, which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the contractor and re-tested.

SG 5.29 Flushing

5.29.1 Upon completion of pressure testing, lines shall be adequately flushed and water samples taken for testing by a Council approved testing authority to the requirements of the National Health and Medical Research Council (NHMRC).

SG 5.30 Tolerances

5.24.1 Tolerances for the construction of water reticulation works shall comply with Table S5.1.

Table S5.1 Construction Tolerances

Description of Works	Tolerance
Alignment	On the allocated alignment (2500m off property boundary)
Hydrants, fittings	Within 0.3m of design relative to side property boundary
Water service connections / conduits	Extend 300mm behind back of kerb, be laid 100mm below pavement subgrade
Valves	Opposite the nearest RP boundary, spaced at 300m apart

SG 6 – Sewerage Reticulation

General

SG 6.1 Scope

6.1.1 This specification details all matters pertaining to Sewerage Reticulation Construction.

6.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

6.1.3 Aspects of modification or clarification of the codes are detailed in Appendix A of Design Guideline – D7

6.1.4 The requirements of this Manual will take precedence over the Water Services Association of Australia Codes

6.1.5 Aspects of medication or clarification of the codes Standard Drawings are detailed in Appendix H and Appendix I.

SG 6.2 Reference Documents

6.2.1 Australian Standards:

- 6.2.2 AS/NZS 1260 Unplasticised PVC (UPVC) Pipes and Fittings for Sewerage Applications
- 6.2.3 AS1289 Methods of Testing Soils for Engineering Purposes
- 6.2.4 AS1432 Copper Tubes for Plumbing, Gasfitting and Drainage Applications
- 6.2.5 AS/NZS1477 PVC Pipes and Fittings for Pressure Applications
- 6.2.6 AS1646 Elastomatic Seals for Waterworks Purposed
- 6.2.7 AS2032 Code of Practice for Installation of PVC Pipe Systems
- 6.2.8 AS2129 Flanges for Pipes, Valves and Fittings
- 6.2.9 AS/NZS2280 Ductile Iron Pressure Pipes and Fittings
- 6.2.10 AS3500 National Plumbing and Drainage Code
- 6.2.11 AS3996 Metal Access Covers, Road Grates and Frames
- 6.2.12 AS4198 Precast Concrete Access Chambers for Sewerage Applications
- 6.2.13 AS4441 Oriented PVC (PVC-O) Pipes for Pressure Applications
- 6.2.14 AS/NZS4765 Modified PVC (PVC-M) Pipe for Pressure Applications
- 6.2.15 AS5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications.

6.2.2 QLD Government Legislation:

- 6.2.2.1 Sewerage and Water Supply Act

6.2.3 Water Services Association of Australia:
- 6.2.3.1 WSA 02 – Sewerage Code of Australia
- 6.2.3.2 WSA 04 – Sewerage Pumping Station Code of Australia

Materials

SG 6.3 Pipes General

6.3.1 All pipes used for sewer reticulation shall be constructed from the following materials:
- 6.3.1.1 Polyvinylchloride (PVC)
- 6.3.1.2 Ductile Iron.

SG 6.4 Unplasticised PVC (PVC-U)

6.4.1 Unplasticised PVC (PVC-U) pipes and fittings for gravity systems shall be manufactured in accordance with AS1260 suitable for rubber ring joints. Pipe classes shall be in accordance with the manufacturers' recommendation and shall be as shown on the approved Project Drawings.

6.4.2 Unplasticised PVC (PVC-U) pipes and fittings for rising mains and suction pipes shall be manufactured in accordance with AS/NZS 1477 minimum Class 12 suitable for rubber ring joints with a mauve coloured pigment.

6.4.3 Modified PVC (PVC-M) pipes manufactured in accordance with AS/NZS 4765 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U.

6.4.4 Oriented PVC (PVC-O) pipes manufactured in accordance with AS 4441 by an Australian Standards quality endorsed company may be used as an alternative to PVC-U.

6.4.5 Rubber Rings shall be manufactured and tested in accordance with AS 1646. They shall be of natural rubber and only those impregnated with a Root Inhibitor shall be used.

6.4.6 All pressure mains 100m diameter and greater shall be D.I.O.D compatible.

SG 6.5 Ductile Iron

6.5.1 Ductile Iron pipes shall be manufactured and cement lined in accordance with AS 2280 by an Australian Standards quality endorsed company.

6.5.2 Socketed Pipes to be Class K9 suitable for the patented "Tyton" type rubber ring joint. Flanged Pipes to be Class K12.

6.5.3 Flanges shall comply with AS 2129 Table C. Bolts and nuts for flanged joints shall be in accordance with AS 2129

6.5.4 All pipes and fittings shall be wrapped in a mauve coloured loose polyethylene sleeving 0.25mm thick. Wrapping and taping shall be carried out in accordance with the pipe manufactures recommendations.

6.5.5 All bends for mains of 100mm diameter or larger and all other associated fittings shall be constructed in accordance with AS2280, and have flange or spigot and socket type joints as specified on the approved Project Drawings. Where flanges are used, bolts shall be matched sets and conform to the following criteria:

6.5.5.1 In above ground uses, bolts shall be Hot Dipped Galvanised

6.5.5.2 In below ground uses, bolts shall be Grade 316 Stainless Steel with nuts and washers Grade 304 stainless steel.

SG 6.6 Polypropylene Pipes

6.6.1 Pipes shall conform to the AS 5065. Pipes shall only be used with the prior approval of Council. “As Constructed” drawings shall clearly indicate location of polypropylene pipes.

SG 6.7 Bedding Materials

6.7.1 After the excavation has been completed, inspected and approved by the Superintendent, the foundation layer of bedding concrete or approved bedding material shall be placed. The minimum bedding depth shall be 100mm of approved material. Refer to Council’s standard drawings

6.7.2 Where directed, pipes shall be bedded on Grade N20 concrete cradle or encased in Grade N20 concrete surround or otherwise bedded in accordance with the drawings or such instructions as may be given by the Superintendent in writing.

6.7.3 Unless shown otherwise on the drawings, no pipes encased in concrete shall extend more than 150mm beyond the face of that concrete. Short pipes laid in sewers shall not exceed 600mm in length and short pipes laid in house connections shall not exceed 300mm in length.

6.7.4 Both approved bedding and approved filling or blanket course to 100mm above the crown of the pipe shall be compacted to 95% of the maximum density as determined by the Standard Compaction Test Department of Transport Q110A 1993.

6.7.5 The material used for bedding, surround and cover for pipes shall be sieved sand, 5mm pea gravel, or 5mm crushed rock free from dust and foreign material.

6.7.6 All junction pipes in a line of sewer shall be concrete bedded and encased with a minimum 150mm cover of Grade N20 concrete unless directed otherwise by the Superintendent.

6.7.7 Concrete blocks in Grade N20 concrete shall be built across the trenches where directed by the Superintendent.

6.7.8 Where passing through concrete, brickwork or masonry, pipes shall be cleaned and washed over with fresh cement grout and bedded on and surrounded with cement mortar at least 12mm clear thickness.

SG 6.8 Concrete

6.8.1 The concrete and reinforcement used in the construction of cast insitu manholes shall comply with Specification SG 7 CONCRETE WORKS.

SG 6.9 Precast Manholes

6.9.1 Precast manhole components shall comply with AS 4198.

SG 6.10 Manhole Covers

6.10.1 Manhole covers and frames shall be supplied for all sewer manholes shall be Cast Iron sealed (gastight) covers manufactured in accordance with AS 3996.

6.10.2 All openings shall conform to the details on Council's Standard Drawing

6.10.3 All covers shall have a raised stud pattern with the letters SEWER (65mm high) cast into the centre of the lid and "gatic" type lifting holes.

6.10.4 Unless noted otherwise on the approved Project Drawings the minimum class of manhole covers shall be Class C or D.

Construction

SG 6.11 Setout

6.11.1 The alignment and grade of sewer lines and position of manholes shall be stated on the approved Project Drawings.

6.11.2 The position of the centre of each manhole shall be pegged on the ground by a Registered Surveyor prior to the commencement of work.

6.11.3 Offset pegs shall be established prior to commencing construction of any line, at a convenient distance to remain clear of all works and remain intact for the duration of the work.

6.11.4 The levels of the sewers shall be maintained in strict accordance with bench marks and only approved and tested equipment shall be used to establish and maintain these levels in accordance with the design documents.

SG 6.12 Clearing & Grubbing

6.12.1 All clearing and grubbing works shall be in accordance with Specification SG 1 EARTHWORKS.

6.12.2 Where sewer lines pass through allotments any trees or obstructions not on the line of the pipes shall be preserved, Clearing and grubbing shall be carried out in accordance with Specification No. 3.1- Earthworks.

6.12.3 The Contractor shall be responsible for all damage to grass, cultivation, fences, building or stock, by fire, falling timber or other causes arising from his operations.

SG 6.13 Trenching

6.13.1 All trenching and foundation works necessary for the installation of the pipeline or thrust blocks, shall be in accordance with Specification SG 1 EARTHWORKS.

6.13.2 The width of trenching excavation shall be in accordance with the Council's Standard Drawing at the trench base and comply with all regulations of Workplace Health and Safety Act.

6.13.3 In undertaking trench excavation, the Contractor shall provide any shoring, sheet piling or other stabilisation of the sides necessary to comply with statutory requirements.

6.13.4 Where public utilities exist in the vicinity of sewer reticulation works the Contractor shall obtain the approval of the relevant authority / corporation to the method of excavation before commencing excavation.

6.13.5 In the event of any trenching being left open for longer than one week, the Contractor shall provide erosion control measures to ensure minimal soil disturbance and material loss off the site. Some or all of these measures shall be provided immediately upon the onset of rain with an open trench.

6.13.6 The Contractor shall leave a clear space of 600mm minimum between the edge of any excavation and the inner toe of spoil banks. No excavated materials shall be stacked against the walls of any building or fence without the written permission of the owner of such building or fence. Topsoil from excavations shall be kept separate and utilised to make good the surface after backfilling.

6.13.7 Where necessary the Contractor must arrange suitable traffic and pedestrian management.

SG 6.14 Crossings

6.14.1 Where a sewer main crosses a State Controlled Road, Railway line or creek, the affected work shall be carried out in accordance with the requirements of

the relevant Authority / Corporation. It shall be the Contractor's responsibility to complete written notification to the Authority / Corporation of the intention to carry out the work.

6.14.2 Where a sewer main crosses an existing road, the affected work shall be carried out in accordance with the requirements of Council. It shall be the Contractor's responsibility to notify Council of the intention to carry out the work.

6.14.3 Unless otherwise approved in writing, all crossing or existing roads and streets shall be bored or jacked with no disruption to the pavement, shoulder or kerb.

SG 6.15 Bedding

6.10.1 Bedding types shall be as detailed on Council's Standard Drawing with the bedding materials complying with the "Bedding Material" section of this Specification.

Type 1 Bedding

6.10.2 The bedding material shall be as specified and shall be placed and compacted for the full width of the trench to the level of the underside of the pipe.

6.10.3 An area of bedding adjacent to the position of the pipe collar should be removed to provide a minimum 20mm clearance to the collar while the remainder of the pipe is bedded evenly on the bedding material.

6.10.4 The remainder of the bedding material is then placed and carefully tamped to avoid disturbing the position of the pipe thus ensuring that the surface of every pipe is in full and even contact with the bedding material.

6.10.5 All bell holes shall be rammed prior to completion of the bedding operation. The bedding material shall be uniformly compacted so as to achieve the following standards:

6.10.5.1 Minimum dry density ratio 95% Standard (cohesive soils).

6.10.5.2 Minimum density index 65% (cohesionless soils)

6.10.6 Compaction requirements are with reference to the relevant Test Methods contained in AS1289.

Type 2 Bedding

6.10.7 Used in wet conditions particularly where the trench bottom requires stabilising the trench invert shall be over excavated to accommodate a "Crushed Rock Foundation" with a geotextile surround.

6.10.8 Water is to be removed from the excavation as work proceeds to allow for placement of the geotextile crushed rock layer. The crushed rock layer shall be laid in 100mm layers and compacted as required.

6.10.9 The geotextile shall surround the crushed rock layer and be overlapped minimum of 500mm.

6.10.10 The pipe bedding material shall placed and compacted over the crushed rock foundation as specified for Bedding Type 1.

Type 3 Bedding

6.10.11 Type 3 bedding incorporating designed piles that are driven by air or electric hammer on a heavy dolly.

6.10.12 Piles shall be driven to give a set in accordance with the design requirements and spaced accordingly as stated on the approved Project Drawings.

6.10.13 A 150 x 50 hardwood sleeper is placed on top of the pile with 150 x 50 hardwood planks spanning the sleepers.

6.10.14 A concrete cradle as detailed on the approved Project Drawings shall then be poured on the planks to support the pipes.

SG 6.16 Laying and Jointing of Pipes

6.16.1 All contractors shall have undertaken a manufacturers pipe laying accreditation course.

6.16.2 All pipelines shall be constructed of pipes of such sizes and laid true to such levels and grades as shown on the approved Project Drawings.

6.16.3 The lines, levels and grades of all lines shall be checked and all pipes found incorrect shall be removed and re-laid.

6.16.4 Trenches shall be kept free of water during pipe laying, and until completion of backfill.

6.16.5 Jointing of pipes, valves and fittings is to be carried out to the manufactures recommendations and in accordance with Australian Standards where applicable.

6.16.6 For pipes with rubber ring joints, only the lubricant specified in writing by the manufacturer shall be applied in making the joint. When the joint is made, the witness mark shall at no point be more than 1mm from the end of the socket.

6.16.7 Before being laid, all pipes, fittings, valves, etc shall be cleaned and examined by the Contractor.

6.16.8 Approved plugs shall be used to prevent foreign matter entering sections of pipeline, which are left uncompleted overnight.

6.16.9 The Contractor shall take all necessary precautions to prevent flotation of pipes during laying, backfilling and initial testing. Any temporary supports shall be removed prior to completion of backfilling.

6.16.10 Pipes may be cut as needed to suit closing lengths, to remove damaged pipe or fittings or to remove sockets if necessary when jointing a socketed fitting.

6.16.11 For field cuts, only an approved mechanical pipe cutter shall be used, except that uPVC pipes may be cut using a power saw or a fine toothed hand saw and mitre box.

6.16.12 Any pipes cut in the field shall have their ends prepared in accordance with the manufacturer's written instructions.

6.16.13 Where pipes are cut in the field, a witness mark shall be made on the pipe at the length specified by the manufacturer from the end of the pipe. Scoring of uPVC pipes shall not be permitted.

6.16.14 Gravity lines shall be constructed to the tolerances specified hereafter:

6.16.14.1 The maximum horizontal deviations to either side from the design axis of a pipeline shall be 100mm for all sizes of pipes.

6.16.14.2 The maximum vertical deviations from the design grade of pipelines of any diameter and grade, shall be + 5mm.

6.16.15 During the progress of the works the Contractor shall have at least two (2) days supply of tested and approved pipes, including junctions on the ground in advance of quantity fixed in position.

SG 6.17 Connections to Manholes

6.17.1 Pipelines shall be connected to manholes, structures or embedded concrete by means of 600mm long pipes such that two flexible joints are provided, the first joint being at the face of the structure. Refer to Council's Standard drawing

6.17.2 The position of the access chamber shall be as shown on the approved Project Drawings. The Contractor shall check the alignment prior to commencing construction and advice the design engineer of any obstructions (Structure, Flora, Services etc)

6.17.3 Allowable lateral deviations from the final design position of access chambers shall be in accordance with the tolerances for horizontal deviations of pipelines as specified. Longitudinal deviations from that position shall not exceed 300mm.

SG 6.18 Connection to Existing Infrastructure

6.18.1 Connection to existing live sewer mains and manholes shall be carried out in accordance with the requirements of Council. It shall be the Contractor's responsibility to notify Council of the intention to carry out and arrange for the timing of such works.

6.18.2 The upstream side of the existing manhole is to be plugged until all new sewer mains have been approved, tested and cleaned.

SG 6.19 Anchor Blocks

6.19.1 Concrete anchor blocks shall be provided in accordance with Council's Standard Drawing for 150 dia. lines laid at a grade of 1 in 6 or steeper and 225 dia. lines laid at 1 in 10 or steeper.

6.19.2 Concrete works shall comply with Specification SG 7 CONCRETE WORKS.

SG 6.20 House Connection Branches

6.20.1 House Connection Branches (HCB) to all properties shall be constructed in accordance with Council's Standard Drawing and to the types, locations, levels and dimensions stated on the approved Project Drawings.

6.20.2 Concrete surrounds shall be provided to all HCB's. All concrete works shall comply with Specification SG 7 CONCRETE WORKS.

6.20.3 Backfill around risers shall be sand compacted to the top of the socket or coupling, for the full width of trench and for a minimum distance of 500mm upstream and downstream of the riser.

6.20.4 The position of each riser, junction or end of a sideline shall be clearly marked by the Contractor on completion of backfilling, with a approved 13mm orange electrical conduit tied to the end of HCB and held in a vertical position during backfilling. The top end of the tape shall be left flush with ground level.

SG 6.21 Rising Mains

6.21.1 All works necessary for the installation of the rising mains including installation of thrust block and anchor blocks, shall be in accordance with Specification SG 5 WATER RETICULATION.

6.21.2 Air release valves and scour valves shall be installed where shown on the approved Project Drawings.

6.21.3 Unless otherwise noted on the approved Project Drawings, pipes for rising mains shall be laid on continuously rising grades from scour valve to air release valve, notwithstanding any minor irregularities in the ground surface.

6.21.4 Marking plates bearing the letters "AV" for air valves, "SV" for scour valves and "RM" at changes of direction and at such chainages that the location of the main is marked at least once each 200 metres.

6.21.5 Sewer rising main connections to discharge manholes are to be constructed in accordance with Council's Standard Drawings.

SG 6.22 Manholes

6.22.1 All concrete work associated with the construction of manholes shall comply with Specification SG 7 CONCRETE WORKS.

6.22.2 Manholes shall be constructed in accordance with Council's Standard Drawing, and to the types, locations, levels and dimensions stated on the approved Project Drawings.

6.22.3 Rendering of this invert and benching shall be in accordance with the Council's Standard Drawing.

6.22.4 Precast manholes are an acceptable alternative with precast base units for Inlet Type A manholes in accordance with Council's standard procedure for pre cast manholes.

6.22.5 Precast Manhole risers are acceptable for use with cast insitu manhole bases.

6.22.6 Precast riser units shall be jointed in accordance with the manufacturers' specifications utilising the recommended method and materials. Inlets into precast units shall be constructed in accordance with the details illustrated on Council's Standard Drawing.

6.22.7 The installation of all precast manhole components shall be in accordance with the manufacturers' recommended procedures, requirements and Council's standard installation procedure.

SG 6.23 Covers and Surrounds

6.23.1 Manhole covers shall be finished flush with the surface in roadways, footpaths and paved surfaces. Elsewhere, unless noted otherwise on the approved Project Drawings, covers shall be finished 50mm above the surface of the surrounding ground, in a manner designed to avoid as far as possible, the entry of surface water.

6.23.2 Manhole covers are to be located such that the position of the access opening is directly over the outlet pipe.

6.23.3 The installation of all precast manhole covers shall be in accordance with the manufacturers' recommended procedures and requirements.

SG 6.24 Backfill and Compaction

6.24.1 Material for the side support and overlay of the pipe shall comply with the pipe bedding material specification. The material shall be compacted in layers of not more than 150mm to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289 Flooding of non-cohesive material shall be considered as an acceptable method of compacting bedding material.

6.24.2 The remainder of the excavation shall be backfilled with excavated material. The backfill shall be compacted in layers of not more than 150mm thick to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289. Flooding of cohesive material shall not be permitted as a means of compacting backfill.

6.24.3 Backfilling and compaction shall be carried out without damaging the pipe or its external coating or wrapping or producing any movement of the pipe.

6.24.4 Where trenches are under constructed pavements or in other situations where required, the material used for backfilling shall be approved excavated material with linear shrinkage of the fines passing a 2.36mm sieve of not greater than 6 per cent. The Contractor may elect to use imported, select fill or sand for this purpose. The backfill shall be spread in layers not exceeding 300mm in loose depth at or near optimum moisture content and compacted using mechanical vibration equipment.

6.24.5 Backfill material down to a depth of 300mm below the underside of the pavement material shall be compacted to 95 per cent of the standard maximum dry density of the material used when determined in accordance with AS1289, and backfill material below such depth shall be compacted to not less than 95 percent of the standard maximum dry density of the material used when determined in accordance with AS1289.

6.24.6 In cases other than those covered by the above clause backfilling above the level of 300mm above the top of the pipes in open trenches may be carried out by dumping from mechanical plant into the trench providing that no rock is placed in the trench until the pipes are covered by at least 300mm of soil backfill.

6.24.7 Compaction testing shall be carried out at a rate of 1 test for each 150 metres of trench backfilled or in the cast where trenches are constructed under road pavements and road shoulders, 1 test for each 25 metres of trench backfilled.

SG 6.25 Cleaning Sewers

6.25.1 Before the sewers, manholes and house drains are accepted they shall be cleaned to remove all clay, sand and other materials.

6.25.2 All water plus materials used in the flushing of the reticulation system shall under no circumstances be discharged into existing sewers downstream of construction. All lines shall be inspected after flushing and will not be accepted until they present a clear barrel, free from any obstruction.

SG 6.26 Test of Manholes

6.26.1 All manholes shall be subjected to hydrostatic or vacuum tests to prove their water tightness unless directed otherwise by the Local Authority.

6.26.2 For hydrostatic tests, all pipe openings out of the manhole shall be plugged and the manhole filled with water to the lowest point on the top of the manhole cover surround. The plugs shall be positioned in the pipes as near as practicable to the internal face of the access chamber. After allowing an interval for absorption, the manhole shall be refilled.

6.26.3 The test on the manhole will be considered satisfactory provided the level does not drop more than 25mm in twenty four (24) hours. The plug of the outlet shall be fitted with a suitable release for emptying the manhole on satisfactory completion of the test.

6.26.4 Manholes failing the test shall be repaired and the test repeated. The process of testing, repair of defects and retesting shall continue until a satisfactory test is obtained.

6.26.5 Where the ground water level is high, an infiltration test may also be required. This shall not take place until ten (10) days after the placing of concrete.

SG 6.27 Testing of Lines

6.27.1 All gravity lines shall be subject to air testing to prove their water tightness unless directed otherwise by the Local Authority.

6.27.2 Testing may be done progressively, a minimum of 24 hours notice shall be provided to Council before commencement of testing. Ensure that pipes are clean before any test is performed.

6.27.3 If any of the tests proved to be unsatisfactory, the contractor shall be required to detect and repair the fault and then re-test. The contractor shall continue to repair and re-test until a satisfactory test is obtained. Even if testing produces satisfactory test results, the contractor shall repair any pipeline or conduit in which there is a visible or detectable leak or blockage.

6.27.4 The contractor shall carry out a visual inspection to ensure that all sewer lines present a full clean bore.

Air Testing General

6.27.5 Air testing shall be either pressure testing or vacuum testing, as directed by the Local Authority. The tests shall include the house connection branches and inspection tee.

6.27.6 Air Testing (Pressure) - The sewer line to be tested shall be pressurised to the "Initial Pressure" shown in the Table S6.2 for a minimum of 3 minutes to stabilise the temperature.

Table S6.2 Pressure Air Testing – Initial Pressures

	Sewer depth range (metres)				
	0-1.5	1.5-3.0	3.0-4.5	4.5-6.0	Over 6.0
Initial Pressure (KPa)	30	35	40	45	50
Test start pressure (KPa)	25	30	35	40	45

6.27.7 After the 3 minute stabilisation period the pressure shall be dropped to the "Test Start Pressure" shown in the above table and the pressure gauge monitored for 5 minutes.

6.27.8 The sewer line under test shall be considered to have passed the test when the pressure does not fall by more than 5 KPa during the 5 minute period.

6.27.9 Air testing (Vacuum) - The sewer to be tested shall be drawn to a vacuum of 28 KPa and the vacuum gauge monitored for 5 minutes. The sewer under test shall be considered to have passed the test when the vacuum does not fall by more then 5 KPa during the 5 minute period.

Ovality Testing

6.27.10 All gravity sewer pipes shall be tested to determine any excessive pipe defection (Ovality) by using a proving tool.

6.27.11 Testing for ovality shall be carried out in accordance with Appendix G of WSA 02-2002 Sewerage Code of Australia

6.27.12 The proving tool shall be:
- 6.27.12.1 Fabricated from steel or aluminium alloy with pulling rings at each end and marked to indicate the nominal pipe size and the provers' outside diameter.
- 6.27.12.2 Rigid, non-adjustable, have an odd-number of legs (min 9) and an effective length of not less than its nominal diameter. The minimum diameter at any point along the length shall be as shown in Table G1 of WSA 02-2002 Sewerage Code of Australia.
- 6.27.12.3 The shape of the proving tool must be approved.

6.27.13 Sewer pipes that exhibit excessive ovality, by failing the maximum allowable deflection as shown above, shall be replaced and the re-laid section retested for ovality.

SG 6.28 Testing of Rising Mains

6.28.1 Hydrostatic pressure testing of all sewer rising mains shall be carried out prior to the acceptance of the works.

6.28.2 The contractor shall have carried out a successful test prior to arranging a Council witness test.

6.28.3 Pressure testing shall not be carried out during wet weather unless otherwise approved by Council.

6.28.4 Before testing a pipeline section, it shall be cleaned and filled slowly with water, taking care that all air is expelled. Purging of air from rising mains shall be promoted by opening air valves.

6.28.5 The hydrostatic test pressure which shall be applied to each section of the pipeline shall be such that at each point of the section the test head shall be equal to or greater than the design head specified or shown on the approved Project Drawings, but shall not exceed same by more than 20 per cent.

6.28.6 The pressure testing of a section shall be considered to be satisfactory if:
- 6.28.6.1 There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component;
- 6.28.6.2 There is no visible leakage; and
- 6.28.6.3 There is no loss of pressure in the 15 minute test period

6.28.7 The specified test pressure shall be maintained as long as required, while the whole section is examined, and in any case not less than 15 minutes.

6.28.8 Any failure, defect, and / or visible leakage, which is detected during the pressure testing of the pipeline or during the Defects Liability Period shall be made good by the contractor.

SG 6.29 Restoration of Surfaces

6.29.1 Pavements, lawns and other improved areas shall be cleaned and left in the same order as they were at the commencement of the works. Lawns shall be

restored with turf cut and set aside from the original surface and / or with imported turf.

6.29.2 All restored surfaces shall be maintained in the condition to which they are restored until the expiry of the Defects Liability Period applicable to those surfaces. Pavements shall be maintained with crushed metal, gravel or other suitable material allowing for consolidation and shall then be restored to a condition equivalent to that of the original pavement.

6.29.3 Immediately the backfilling of a trench excavated through a pavement has been completed, the pavement shall be temporarily restored. Where the trench crosses bitumen or concrete pavement, a pre-mixed asphaltic material shall be used for such temporary restoration. Temporary restoration works shall be maintained by the Contractor until final restoration is carried out.

6.29.4 Final restoration of the pavement shall be carried out to restore the pavement and its subbase to no less than the original condition. Unless noted otherwise on the approved Project Drawings all trenches excavated through bitumen or concrete pavement shall be sawcut each side to facilitate a neat finish to the final restoration. Final restoration may include, if required, the removal of temporary restoration.

6.29.5 Backfill shall be placed sufficiently high to compensate for expected settlement and further backfilling shall be carried out or the original backfill trimmed at the end of the Defects Liability Period in order that the surface of the completed trench may then conform to the adjacent surface. Surplus material shall be removed and disposed of to areas arranged by the Contractor.

6.29.6 In locations where surplus material left in the vicinity of the trench would not be objectionable, the surplus material may be disposed by spreading neatly in the vicinity of the trench in such a way as to minimise future erosion of the backfill and adjacent ground surfaces. The Contractor shall maintain the backfill and adjacent ground until the end of the Defects Liability Period.

6.29.7 Where, within public or private property, the reasonable convenience of persons will require such, trenches to be levelled off at the time of backfilling. Any subsequent settlement shall be made good by the Contractor, as required by placing additional fill.

6.29.8 Where shown on the approved Project Drawings or where the Contractor elects to tunnel under paving, kerb and channel or other improved surfaces in lieu of trenching, backfilling shall be so carried out as to restore full support to those surfaces. The Contractor shall remain responsible for the repair of the improved surfaces, if subsequently damaged due to subsidence of the backfill, until the end of the Defects Liability Period.

SG 6.30 Tolerances

6.30.1 Tolerances for the construction of sewer reticulation works shall comply with Table S6.4.

Table S6.4 Construction Tolerances

Location	Tolerance
Invert Levels	+25mm - -25mm
Location of alignment and structures	Lateral deviation from line + 100mm Longitudinally along line + 300mm
Grade on pipe	Design grade not compromised

SG 7 – Concrete Works

General

SG 7.1 Scope

7.1.1 This specification details all matters pertaining to the supply, placement, compaction and finishing of Concrete Works.

7.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

SG 7.2 Reference Documents

7.2.1 Australian Standards

7.2.1.1 AS1012 Methods of Testing Concrete

7.2.1.2 AS1379 The Specification and Manufacture of Concrete

7.2.1.3 AS1478 Chemical Admixtures for Concrete

7.2.1.4 AS1553.1 Low Carbon Steel Electrodes for Manual Arc Welding of Carbon Steels and Carbon-Manganese Steels

7.2.1.5 AS1554.3 Welding of Reinforcing Steel
7.2.1.6 AS2203 Cored Steel Electrodes for Arc Welding
7.2.1.7 AS2717.1 Ferritic Steel Electrodes
7.2.1.8 AS3600 Concrete Structures
7.2.1.9 AS3610 Formwork for Concrete
7.2.1.10 AS3735 Concrete Structures for Retaining Liquids
7.2.1.11 AS3799 Liquid Membrane-forming Curing Compounds for Concrete
7.2.1.12 AS/NZS4671.2 Steel Reinforcing Bars for Concrete
7.2.1.13 AS/NZS4671.3 Steel Reinforcing Wire for Concrete
7.2.1.14 AS/NZS4671.4 Welding Wire Reinforcing Fabric for Concrete.

Materials

SG 7.3 Concrete – General

7.3.1 All concrete to be incorporated in the works shall be sourced from a Quality Assured Concrete supplier.
7.3.2 The production and delivery of ready-mixed concrete shall be in accordance with the requirements of AS 1379.
7.3.3 The quantity of concrete delivered in any truck shall not exceed the rated capacity of its agitator drum. The timing of deliveries shall be such as to ensure an essentially continuous placing operation.
7.3.4 Ready-mixed concrete shall be placed and compacted within 1 hour of charging the mixer for concrete temperatures up to 32°c and within 45 minutes of charging the mixer for concrete temperatures exceeding 32°c.
7.3.5 The Consulting Engineer's discretion where approved set-retarding admixtures are used. In this instance approved admixtures shall conform with the requirements of AS 1478 and shall be used in accordance with AS 1379. Calcium Chloride shall not be used as an admixture in concrete works.
7.3.6 A Manufacturer's Certificate in the form of a delivery docket in accordance with AS 1379 shall be supplied for each batch and shall be retained by the Contractor. Such certificates shall be held and maintained in the Contractors Quality records for the project. Further, the Contractor shall obtain a statement from the manufacturer qualifying the quality standard of the concrete in accordance with the requirements as specified herein.
7.3.7 The consistency and workability of concrete shall be such that it can be handled and transported without segregation and can be placed, worked and compacted into all corners, angles and narrow sections of forms, and around all reinforcement.
7.3.8 Concrete class shall be classed as Nx where x is the minimum 28-day compressive strength in megapascals.
7.3.9 For construction elements involving structural concrete construction activities, (eg. bridge slabs, bridge abutment footings etc.) the concrete class and slump shall be as detailed in the Project Documentation. The material quality

compliance testing in this instance shall involve on-site sampling and testing in accordance with Australian Standard AS 1012. The testing of the 200mm x 100mm diameter test cylinders shall be at a frequency not exceeding one sample of 2 cylinders for each 15m3 or part thereof placed in an essentially continuous manner with a minimum of two samples of 2 cylinders for each casting day.

7.3.10 All testing shall be undertaken by a NATA registered testing authority. 11.The class of concrete relative to each construction element shall be as shown in Table S7.1.

Table S7.1 Concrete Classes

Construction Element	Class[1]
Kerb/Kerb & Channel	N 25
Manholes (Sewer & Stormwater)[2]	N25 or N32 as shown on Standard Drawings
Gully Pits / Field Inlets[2]	N25 or N32 as shown on Standard Drawings
Headwalls/Wingwalls & Apron Slabs[2]	N 25
Pathways / Bikeways	N 25
Access Driveways	N 25
Edge Restraints for Segmental Pavers (On Road Pavements)	N 25
Edge Restraints for Segmental Pavers (On footpaths, bikeways and medians)	N 20
Stamped Concrete (where used in road pavement)	N 32
Stamped Concrete (where used as parking bay behind kerb or not subject to regular street traffic loadings)	N 25
Thrust Blocks	N 20
Concrete Surrounds for Sewerage House Connection Branches	N 20
Concrete Cradle for Sewer Bedding Type 3	N 15
General Concrete Works (Sign Post Bases, Bases for Post and Rail Fences etc.)	N 20
Notes: 1. **Tested in accordance with the relevant sections of AS 1012.** 2. **Where any part of the structure is located below RL 1.800 AHD,**	

	concrete to be in accordance with the appropriate exposure condition in AS3600

SG 7.4 No Fines Concrete

7.4.1 No fines concrete shall consist of cement, water and coarse aggregate. The quantity of cement used shall be as specified below. The nominal size of the aggregate for no-fines concrete shall conform with the grading limits specified in Table S7.2.

7.4.2 The water / cement ratio shall be within the range 0.5 to 0.6 by mass.

Table S7.2 No Fines Concrete – Grading Limits

AS Metric Sieve (mm)	Percentage Passing By Mass	
	Nom. Size 20mm	Nom. Size 10mm
26.5	100	-
19.0	85-100	-
13.2	0-10	100
9.5	0-5	85-100
4.75	0	0-10
2.36	0	0-2
Minimum Cement Content (kg/m^3)	210	250

SG 7.5 Lean Mix Concrete

7.5.1 Lean mix concrete shall consist of a graded sand and gravel aggregate of 40mm maximum size with the addition of 5% by mass of Portland Cement or 1 part Portland Cement to 19 parts of graded aggregate and sufficient water to ensure a slump of less than 12mm.

SG 7.6 Reinforcing Steel

7.6.1 All reinforcement shall comply with the following requirements where applicable:

7.6.1.1 Steel Reinforcing Bar - AS/NZS4671.2 Steel Reinforcing Bars for Concrete

7.6.1.2 Hard-draw Steel Reinforcing Bar - AS/NZS4671.3 Steel Reinforcing Wire for Concrete

7.6.1.3 Reinforcing Wire Fabric - AS/NZS4671.4 Welding Wire Reinforcing Fabric for Concrete

7.6.2 All reinforcement shall be sourced from and Quality Assured manufacturer of such products and the Contractor shall obtain a statement from the manufacturer qualifying the Quality Standard of the reinforcing steel in accordance with the above noted standards.

Construction

SG 7.7 Temperature Limits for Concrete Placement

7.7.1 No concrete shall be placed in the Works if:

7.7.1.1 The temperature of the concrete is less than 5°C or exceeds 30°C;

7.7.1.2 The ambient air temperature is likely to be greater than 45°C during placement or within two (2) hours subsequent to placement.

7.7.2 If the ambient air temperature measured at the point of placement is likely to exceed 30°C during placing and finishing operations, the Contractor shall take practical precautions, to ensure that the temperature of the concrete does not exceed the permitted maximum so that the concrete can be placed and finished without defects, otherwise it shall be rejected. Typical precautions include those listed below:

7.7.3 At the concrete manufacturing plan:

7.7.3.1 Shading aggregate stockpiles;

7.7.3.2 Painting water tanks white;

7.7.3.3 Insulating or burying delivery lines;

7.7.3.4 Adding crushed ice to replace mixing water (in part) or chilling the water;

7.7.3.5 Injection of liquid nitrogen into the mixer.

7.7.4 At the site:

7.7.5 Cooling the formwork by dampening with water sprays;

7.7.6 Shading the work areas;

7.7.7 Erecting wind breaks;

7.7.8 Minimising the time for placing and finishing;

7.7.9 Use of evaporation retarding curing oil.

7.7.5 Special attention shall be paid to providing early curing for hot weather concreting operations.

SG 7.8 Foundations

7.8.1 Foundations for concrete structures shall be prepared as specified on the Project Drawings.

7.8.2 Rock foundations shall be neatly excavated to form a bed for the concrete, and shall be thoroughly scraped and cleaned.

7.8.3 Soil foundation shall, as far as possible, be excavated neatly from the solid material to coincide with the under-surface of the concrete, or of the subbase material (where specified).

7.8.4 All soft, yielding or other unsuitable material shall be replaced with sound material and the subgrade shall be compacted to provide a minimum of 95 per cent standard compaction as determined by AS 1289.5.4.1 for standard compactive effort. If the subgrade is dry it shall be sprinkled with as much water as it will readily absorb, before the concrete is placed.

7.8.5 The surface shall then be checked for uniformity, line and level, and all irregularities shall be made good.

SG 7.9 Formwork and Falsework

7.9.1 All Formwork and Falsework shall conform to AS 3610 unless otherwise required by the specific Project Documentation.

7.9.2 All forms shall be built mortar tight and of sufficient rigidity to prevent distortion by the pressure of the concrete and other loads incident to the construction operations. Forms shall be constructed and maintained to prevent warping and the opening of joints due to shrinkage of the timber. The forms shall be substantial and unyielding and shall be so designed and set that the finished concrete will conform to the proper dimensions and within the tolerances specified herein. The design of the forms shall take into account the effect of vibration of the concrete as it is placed.

7.9.3 When forms are re-used, their original shape, strength, rigidity, mortar tightness and surface smoothness shall be maintained at all times. Material previously used in formwork must be cleaned off and oiled before re-use. Warped timber shall not be used.

7.9.4 Forms, which are unsatisfactory in any respect, shall not be re-used.

7.9.5 All timber shall be free from knotholes, loose knots, cracks, splits, warps and other defects, which would affect the strength of the structure or the appearance of exposed surfaces.

7.9.6 For narrow walls and columns where the bottom of the form is otherwise inaccessible, openings shall be provided so that they may be cleaned before placing the concrete, and for purposes of compaction and inspection.

7.9.7 All forms shall be treated with the lightest practical coating of release agent before the reinforcement is placed. Release agent shall not be placed on reinforcement or construction joints.

7.9.8 All forms shall be set and maintained to the line and level designated. Forms shall remain in place for periods, which shall be determined as specified herein. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the work shall not proceed until the defects have been corrected.

7.9.9 Metal form ties shall be of an approved type, and if cast in, shall be of a type which permits removal of the end fittings to a depth of at least 30mm below the finished surface of the concrete. Ordinary wire ties shall not be used.

7.9.10 Form ties shall be located in a uniform symmetrical pattern relative to the finished surface. The cavities left when the end fittings of embedded ties are removed shall be as small as possible and shall be filled with cement mortar at the earliest possible time. The surface of such filled cavities shall be left smooth and uniform in colour.

7.9.11 Forms for plain exposed surfaces shall consist of plastic-coated plywood, waterproof plywood, timber lined with tempered hard-board or close-fitting unwarped metal forms. Unless otherwise specified, joints in the form sheeting for plain exposed concrete surfaces shall be either vertical or horizontal and spaced with a regular pattern.

7.9.12 Forms for surfaces not exposed to general view may consist of modular timber or metal panels. Timber forms shall be constructed and maintained in such a manner as to prevent warping and opening of joints due to shrinkage of the timber. The timber shall be free of any defects, which will affect the structure.

7.9.13 Forms shall be removed with care and without unnecessary hammering or wedging, and so as not to injure the concrete or disturb the remaining supports. Methods of form removal likely to cause overstressing of the concrete shall not be used.

SG 7.10 Reinforcing Steel

7.10.1 Reinforcement shall be free of kinks or other unwanted deformations, and shall be cut to length, and bent in accordance with the Project Drawings. Fabric reinforcement shipped in rolls shall be straightened into flat sheets before use.

7.10.2 The surface condition of reinforcement shall comply with the following requirements:

7.10.2.1 At the time concrete is placed reinforcement shall be free from mud, oil, grease and other non-metallic coatings and loose rust which would reduce the bond between the concrete and the reinforcement.

7.10.2.2 For the purpose of this Specification, rust shall not be deemed to be loose if on rubbing with the thumb it leaves only a stain thereon.

7.10.2.3 Nevertheless, a deformed bar complying with AS 1302, or a welded wire fabric complying with AS 1304, and having mill scale or rust or both shall be deemed to comply with this Specification if, after wire-brushing the cross-sectional dimensions, including height of deformations; and mass, are not less than the dimensions and mass required by the applicable Australian Standard.

7.10.2.4 Any reinforcement projecting from a previous concreting operation shall be cleaned free of adhering concrete or loose slurry prior to any further embedment.

7.10.2.5 Any reinforcement placed within 1km of the coastline shall be thoroughly washed with a high pressure fresh water jet immediately

prior to pouring concrete to remove any salts deposited during storage and placement.

7.10.2.6 Reinforcement which has been submerged by tidal or flood waters shall also be cleaned with a high pressure fresh water jet prior to pouring concrete.

7.10.3 Reinforcement shall be placed in position as shown on the Project Drawings. In the case of bar reinforcement, the bars shall be tied together by wiring each intersection using annealed wire not less than 1.25mm in diameter or by such other fastening devices as may be approved by the Designer, provided that, where the bar spacing is 300 mm or less, alternate intersections only need to be tied.

7.10.4 Clearance from forms shall be maintained by use of approved chairs. The shape of the chair shall be such that minimum obstruction is offered to the formation of the homogeneous concrete both within and around the chair. Tubular or cylindrical types shall not be used. Some bar chairs are suitable for soffit use only and should not be used against side forms. Bar chairs shall be sufficient structural strength to support the weight of reinforcement and workmen at temperatures experienced on site.

7.10.5 Metal chairs shall not be approved for any locations.

7.10.6 Precast mortar blocks shall not be used unless the blocks are manufactured from vibrated concrete of strength equivalent to that of the main concrete, and to a size and shape so as not to interfere with the structural integrity of the works. Such blocks shall have suitable fixing wires cast-in.

7.10.7 Layers of bars shall be separated by means of approved bar spacers. Stirrups and ligatures shall pass around the main reinforcement and shall be securely tied thereto.

7.10.8 Reinforcement shall be spliced by lapping or where permitted, by welding or by approved mechanical splices. Fabric reinforcement shall be lap spliced only.

7.10.9 The system of fixing shall be such as to form a rigid cage which maintains dimensional tolerances under loads experienced during placement of concrete. Welding of reinforcement to form a rigid cage shall comply with the following requirements:

7.10.9.1 Welding shall be in accordance with AS 1554.3. In particular tack welds shall not substantially reduce the cross-section of the reinforcing steel nor adversely affect its strength and shall have:

7.10.9.1.1 A throat thickness not less than 4 mm;

7.10.9.1.2 A length not less than the diameter of the smaller bar.

7.10.9.2 Welding shall not be carried out within 75 mm of any portion of a bar which has been bent or will be bent.

7.10.9.3 No more than one-third of the main reinforcement at any cross-section shall be so welded.

7.10.9.4 Hard drawn wire and fabric reinforcement shall not be welded or heated unless approved by the Engineer.

7.10.9.5 Welding electrodes that are to be used complying with AS 1553.1 or AS 2203 or AS 2717.1.

7.10.9.6 Splices shall be made by butt or by fillet welding. Butt welds shall be qualified complete penetration butt joints in accordance with AS 1554.3.

7.10.9.7 Suitability experienced and competent welding personnel shall be engaged to complete the works.

7.10.10 Splicing of reinforcement shall occur only in the locations shown on the Project Drawings. Where practical, splices in bar reinforcement shall be staggered.

7.10.11 The length of lap splices in bar reinforcement shall be as shown on the Project Drawings. All reinforcement shall be spliced in such a manner as to maintain specified clear cover to the surface of the concrete. Splicing of fabric reinforcement shall be achieved so that the two outermost transverse wires of one sheet of fabric overlap the outermost transverse wire of the sheet being lapped.

SG 7.11 Concrete Placement – General

7.11.1 The Contractor shall be solely responsible for placing and compacting the concrete in the forms to comply with this Specification and for achieving dense, sound concrete without voids and to the lines and levels shown on the Project Drawings.

7.11.2 When rain threatens or seepage exists in excavations, the Contractor shall have on site sufficient dewatering equipment and covers as applicable to prevent any additional water entering the concrete.

7.11.3 Concrete shall be placed in an essentially continuous manner between approved construction joints so as to avoid being placed against partially set concrete.

7.11.4 Any troughs and chutes used as aids in placing concrete shall be metal or metal lined and shall be arranged and used in a manner that does not cause segregation. The use of water to facilitate the movement of concrete along troughs or chutes is expressly prohibited, but all troughs and chutes shall be kept clean and free of coating of hardened concrete by flushing thoroughly with water, which shall be discharged well clear of concrete in place.

7.11.5 Troughs and chutes shall discharge into vertical downpipes at least 1 metre in length. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement so that the concrete slides without segregation.

7.11.6 Pneumatic placers and concrete pump may be permitted for use subject to such equipment being arranged so that no vibrations will damage freshly placed concrete. The delivery end of the pipe shall terminate in a fitting of approved design, which shall prevent segregation of the concrete. After the completion of any concreting operations the equipment shall be thoroughly cleaned before re-use.

7.11.7 Concrete shall not be dropped from a height or in such a manner as will cause segregation or loss of material on the reinforcing steel or forms. When placing operations would involve dropping the concrete more than 2 metres it shall be

deposited through a sheet metal or other approve downpipe in such a way that the concrete does not segregate. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. The depositing of a large quantity of concrete at any point with the intention of moving it along the forms, will not be permitted.

7.11.8 After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcing bars which project.

SG 7.12 Concrete Placement – Under Water

7.12.1 Concrete shall not be placed under water unless specifically approved. The slump of the concrete to be placed underwater shall be between 150mm and 200mm.

7.12.2 Concrete shall not be placed in running water. Any pumping must cease and the water level must be constant where placement commences. The concrete shall be placed carefully in position by a tremie, a closed bottom-dump bucket or by other approved means. Concrete seals shall be placed in one continuous operation, the concrete shall not be disturbed after being deposited and the placing shall be regulated to continually maintain an approximately horizontal surface.

7.12.3 When a tremie is used it shall consist of a watertight tube and at no time shall concrete in the tube come in contact with water when it is being filled. The means of supporting the tremie shall be such as to permit free movement of the discharge end and to permit its being lowered rapidly when necessary to choke off or retard the flow of concrete. No water shall enter the tremie tube. The discharge end shall be completely submerged in concrete at all times and the tremie tube shall always be filled to a height to overcome the head of water.

7.12.4 When concrete is placed with a bottom-dump bucket, the bucket shall be lowered gradually and carefully until it rests upon the prepared foundation or upon concrete already placed. It shall then be raised slowly during the discharge travel so as to maintain as far as is practicable still water at the point of discharge and to avoid agitating the mixture. The concrete so placed shall not be disturbed.

SG 7.13 Compaction in Concrete Forms

7.13.1 Concrete during and immediately after depositing shall be thoroughly compacted. Concrete other than no fines concrete shall be compacted with high frequency internal vibrations as follows:

7.13.1.1 The vibrators shall be of an approved type and shall be capable of transmitting vibrations at a frequency not less than 150 Hz with an intensity which will visibly affect the concrete at a radius of 300mm.

7.13.1.2 The number of vibrators to be used by the Contractor shall be not less than one for each $4m^3$ of concrete placed per hour, with a minimum of 2 vibrators to be provided at any time.

7.13.2 Vibrators shall be inserted vertically at successive positions not more than 450mm apart and in a manner, which ensures compaction of the concrete around the reinforcing steel and any other embedded fixtures, and into all parts of the forms.

7.13.3 Vibration shall continue at each position until air bubbles cease to emerge from the concrete. The vibrators shall then be withdrawn slowly so as to avoid leaving a "pocket". The vibration shall be of sufficient duration to thoroughly compact the concrete, but shall not be continued so as to cause segregation.

7.13.4 Care shall be taken to ensure that newly deposited concrete is vibrated into any fresh concrete adjacent to it to provide a homogeneous concrete mass.

7.13.5 Vibration shall not be applied either directly or through the reinforcement to any concrete, which has taken its initial set.

SG 7.14 Removal of Forms and Falsework

7.14.1 Unless otherwise specified, forms and falsework shall remain in position until the times stated below have elapsed after completion of concreting:

7.14.1.1 Non structural concrete - Until such time as the concrete has reached 50% of the characteristic 28-day strength or a period of 3 days, whichever is the lesser.

7.14.1.2 Structural Concrete - Soffits of slabs, headstock and diaphragms - Until such time as the concrete has reached 70% of the characteristic 28-day strength or 7 days, whichever is the lesser. For side forms on structural concrete - 3 days minimum.

7.14.2 Where the timing for the removal of forms is based on concrete strength as specified herein, the strength shall be proven by testing in accordance with AS 1012.

7.14.3 Forms shall be removed with care, without hammering and wedging, and in a manner, which will not injure the concrete or disturb the remaining supports. Centre Forms shall be lowered gradually and uniformly in such a manner as to avoid injurious stress in any part of the structure.

7.14.4 Hole formers such as pipes and bars shall be removed as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

SG 7.15 Finishing of Exposed Surfaces

7.15.1 Unless otherwise specified in the Project Documentation, all surfaces of concrete exposed to view in the completed structure shall be finished in accordance with the following:

7.15.1.1 Kerb and channel, invert crossings, vehicle crossings and industrial crossings shall be finished with an approved steel finishing tool.

7.15.1.2 Footpaths, bikeways and pram ramps shall be finished with a wooden float and broomed.

7.15.1.3 Where a sample panel is supplied or specified associated with a particular project. The concrete finish shall be in accordance with the specified requirement.

7.15.2 All concrete surfaces shall be true and even, free from stone pockets, depressions or projections beyond the surface. All arises shall be sharp and true, and mouldings shall be evenly mitred or rounded. Care shall be exercised in removing forms to ensure this result.

7.15.3 Immediately after removal of forms from mass or reinforced concrete work, all rough places, holes and porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and shall be brought to an even surface with a wooden float.

7.15.4 Any tie wires or other fitments extending to outside surfaces, shall be cut back after removal of forms, to a depth of at least 40mm with sharp chisels or cutters. All cavities caused by removal of fitments or tie wires shall be wetted and carefully packed with cement mortar, as above.

7.15.5 The surfaces of bolt cavities, tie wire holes, and all defects in concrete shall be coated prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water. The method of application of such agent and the conditions in which it is to be used shall generally be as laid down by the manufacturer.

SG 7.16 Weepholes

7.16.1 Drainage adjacent to weepholes shall be provided by either a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50mm to 10mm such that:

7.16.1.1 The maximum particle dimension shall not exceed 50mm

7.16.1.2 No more than 5 per cent by mass shall pass the 9.5mm A.S. sieve. 2. The broken stone or river gravel, enclosed in a filter fabric suitable for drainage without scour, shall be continuous in the line of the weepholes, extend at least 300mm horizontally into the fill and extend at least 450mm vertically above the level of the weepholes.

7.16.2 Alternatively the Contractor may provide a synthetic membrane of equivalent drainage characteristics. It shall be stored and installed in accordance with Manufacturer's instructions.

SG 7.17 Joints

7.17.1 Where horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures the joints may be made at the base of walls and at other locations in the walls where approved by the Consulting Engineer. In order to provide for bond between the new concrete and the concrete which has already set, the surface on which the new concrete is to be placed shall be thoroughly cleaned of loose material, foreign matter and laitance. The surface shall be roughened or keyed and saturated with water. After any excess water has been removed, the surface shall be thinly coated with a neat cement grout.

7.17.2 Where vertical expansion joints are shown on the approved Project Drawings in retaining walls or other walls and structures the expansion joints shall consist of jointing material of approved quality, and of thickness stated on the drawings, and a depth sufficient to fill the joint. The jointing material shall be neatly cut to fit the surface of the concrete.

7.17.3 Extruded or cast in place kerbing, shall have narrow transverse vertical grooves, 40mm deep and not more than 6mm wide, formed neatly in the surface of the freshly placed concrete to produce contraction joints for the control of cracking. The contraction joints shall be at intervals not exceeding 3 metres.

7.17.4 In footpaths, median toppings and driveways, unless otherwise shown on the approved Project Drawings, expansion joints, 10mm in width for the full depth of paving, shall be constructed at intervals not exceeding 16m and where the pavement abuts against gutters, pits and structures. Expansion joints shall have an approved preformed jointing material. In addition, narrow vertical grooves 20mm deep and not more than 6mm wide shall be formed at internals not exceeding 2m to induce contraction joints for the control of cracking.

7.17.5 All unreinforced paving shall be provided with narrow vertical grooves, 20mm deep and not more than 6mm wide to induce contraction joints for the control of cracking. The joints shall be formed in the freshly placed concrete in a neat regular pattern to form "slabs" no bigger than $2m^2$. The ratio of the longest side to the shortest side shall not exceed 1.6.

SG 7.18 Curing

7.18.1 The curing of unformed surfaces of concrete shall commence as soon as finishing operations are complete.

7.18.2 If forms are removed in less than 7 days, curing of the formed surface shall commence within two hours of stripping.

7.18.3 Curing shall continue for a period after placing the concrete of not less than:

7.18.3.1 Top surface of slabs - 14 days;

7.18.3.2 Other surfaces - 7 days.

7.18.4 Curing shall be effected by either Water or Membrane Curing.

7.18.5 Water curing shall comprise surfaces being kept moist for the period specified by continuous spraying, ponding, wet hessian or wet sand blankets.

7.18.6 Membrane curing shall be effected by application of a sprayed curing compound or by covering with polythene sheet.

7.18.7 Sprayed curing compounds shall be of a paraffin wax emulsion type formulated and tested by the manufacturer to conform to AS 3799. The compound shall be mixed if necessary and applied at the rate recommended by the manufacturer.

7.18.8 Resin and PVA based compounds shall not be used.

7.18.9 Polythene sheet shall be of sufficient strength to withstand wind and any imposed foot traffic. Torn or punctured sheeting shall not be used. Laps should be 300mm minimum and edges and laps shall be sealed by tape or held down by boards or reinforcing bars. Water shall be sprayed under the sheeting at edges and at laps on the day after placing concrete and at regular intervals to maintain moist conditions.

SG 7.19 Backfilling

7.19.1 Backfilling at barriers, paving, etc, and minor concrete works shall not commence until after the concrete has hardened and not earlier than three days after placing.

7.19.2 No filling shall be placed against retaining walls, headwalls or wingwalls within 21 days after placing of the concrete, unless the walls are effectively supported by struts or when the Contractor can demonstrate that 85 per cent of the design strength of the concrete has been achieved.

7.19.3 Selected backfill shall be placed against retaining walls and cast-in-place box culverts for a horizontal distance equal to one-third of the height of the wall. It shall consist of granular material, free from clay and stone larger than 50mm gauge. The Plasticity Index of this selected backfill material shall not be less than 2 or more than 12 when tested in accordance with AS 12893.3.1. The material shall be placed in layers not exceeding 150mm and shall be compacted to provide a relative compaction of not less than 98 per cent as determined by AS 1289.5.4.1 for standard compactive effort.

SG 7.20 Sprayed Concrete

7.20.1 The minimum depth of sprayed concrete to be applied shall be 75mm.

7.20.2 Sprayed concrete shall have a minimum 28-day compressive strength of 25 MPa.

7.20.3 Earth surfaces shall be graded, trimmed and compacted and shall be dampened prior to applying the sprayed concrete. The Contractor shall take any precautions necessary to prevent erosion when the sprayed concrete is applied.

7.20.4 Rock surfaces shall be cleaned of loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. The rock surface shall be dampened prior to applying the sprayed concrete.

7.20.5 The Contractor shall remove free water and prevent the flow of water, which could adversely affect the quality of the sprayed concrete.

7.20.6 Application shall begin at the bottom of the area being sprayed and shall be built up making several passes of the nozzle over the working area. The nozzle shall be held so that the stream of material shall impinge as nearly as possible perpendicular to the surface being coated. The velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix shall be regulated so as to produce a dense coating with minimum rebound of the material and no sagging. Rebound material shall be removed after the initial set by air jet or other suitable means from the surface as work proceeds and disposed of.

7.20.7 Spraying shall be discontinued if wind causes separation of the nozzle stream.

7.20.8 Concrete shall not be sprayed in air temperatures less than 5°C.

7.20.9 Construction joints shall be kept to a minimum. A joint shall be formed by placing or trimming the sprayed concrete to an angle between 30° and 45° surface. The joint edge shall be cleaned and wetted by air-water jet before recommencing concrete spraying.

7.20.10 When spraying around reinforcement, concrete is to be sprayed behind the reinforcement before concrete is allowed to accumulate on the face of the reinforcement.

7.20.11 Adjoining surfaces not requiring sprayed concrete shall be protected from splash and spray rebound. Splash or rebound material on these adjoining surfaces shall be removed by air-water jet or other suitable means as work proceeds.

7.20.12 Curing shall commence within one hour of the application of sprayed concrete and may be by water or by colourless wax emulsion curing compound complying with AS 3799 and applied in accordance with manufacturer's specifications.

7.20.13 In water curing, the surface of the sprayed concrete shall be kept continuously wet for at least seven days.

SG 7.21 No Fines Concrete

7.21.1 Where no fines concrete is incorporated in the works it shall be rodded sufficiently only to ensure the form is completely filled. It shall be screeded to the required surface level without tamping or vibrating. No fines concrete shall be moist cured for at least four (4) days by covering with wet hessian, polythene sheet or other similar materials. The use of wet sand or any other material, which can enter the voids, will not be permitted for curing purposes.

SG 7.22 Tolerances

7.22.1 Where tolerances for individual components and associated dimensions are not specified on the Project Drawings, deviations from established lines, grades and dimensions in the completed work shall not exceed the values stated herein.

7.22.2 The dimensional tolerances as shown in Table S7.3 are to cover strength, durability and fit of prefabricated elements and cast-in-situ elements.

Table S7.3 Dimensional Tolerances

Description	Tolerance (mm)
Cross-sectional dimension of members and thickness of slabs	+ 10, - 3
Length of members, length and width of slabs: **- Up to 18m dimension** **- 18m or over dimension**	± 6 1mm for every 3m in length
Clear cover to reinforcement	+ 6, - 3
Fitments for prefabricated elements – girder anchorages (including dimensions between anchorages on adjacent piers), cored holes, handrail anchorages and other embedded items	± 5 max. 1mm for every 1m in length

7.22.3 Positional tolerances, as shown in Table S7.4 refer to the departure of any point, plane or component of a structure from its correct position within the layout of the structure as shown on the Project Drawings.

Table S7.4 Positional Tolerances

Description	Tolerance (mm)
Level of Footings	± 20
Level other than footings	± 5
Horizontal location, where tolerances on fit is not acceptable	± 25

7.22.4 Relative tolerances refer to departures from linearity or planarity in any part of the structure. Tolerances are measured as the departure of any point in a line or surface from the remainder of that line or surface.

7.22.5 Departure may be sudden (e.g. misfit at joint in formwork) or gradual (e.g. a wobble in the surface). Tolerance on gradual departure is the value calculated by multiplying the overall length of the line or surface under consideration by the factor given below in Table S7.5.

Table S7.5 Relative Tolerances

Description	Tolerance (mm)
Exposed edge – gradual departure	0.001
Exposed surface – gradual departure	0.004 (10mm max.)
Exposed surface – sudden departure	3 mm max

SG 8 Landscaping

General

SG 8.1 Scope

8.1.1 This specification details all requirements pertaining to Tree Planting, Grassing, Turfing, Hydromulching and Irrigation works associated with permanent and temporary revegetation works.

8.1.2 Where there is any conflict determined between the requirements specified herein and the requirements of any referenced Australian Standard, Statutory Authority Standards or otherwise, the requirements specified herein shall apply.

SG 8.2 Reference Documents

8.2.1 Australian Standards:
- 8.2.1.1 AS1432 Copper Tubes for Plumbing, Gasfitting and Drainage Applications
- 8.2.1.2 S/NZS1477 PVC Pipes and Fittings for Pressure Applications
- 8.2.1.3 AS2032 Code of Practice for Installation of PVC Pipe Systems
- 8.2.1.4 AS2507 The storage and Handling of Pesticides
- 8.2.1.5 AS2845 Water Supply – Back Flow Prevention Devices
- 8.2.1.6 AS3785 Solvent Cements and Priming Fluids for Use with UPVC Pipes and Fittings
- 8.2.1.7 AS4419 Soils for Landscaping and Garden Use
- 8.2.1.8 S4454 Composts, Soil Conditioners and Mulches

8.2.2 Queensland Legislation:
- 8.2.2.1 Queensland Land Protection Act (2002)

8.2.3 Whitsunday Regional Council:
- 8.2.3.1 Biosecurity Plan 2016-2020

Materials

SG 8.3 Grass Seeding

8.3.1 The grass seeding species mix shall consist of the following:
- 8.3.2 30% Cynodon Dactylon (green couch) – hulled
- 8.3.3 30% Cynodon Dactylon (green couch) - unhulled
- 8.3.4 30% Axonpus Affinis (carpet grass)
- 8.3.5 10% Tetila Rye (in dry season) or Japanese Millet (in wet season)

8.3.6 The accepted final mix shall be dependent upon local conditions, soil properties, and method of works.

SG 8.4 Turfing

8.4.1 Turf shall consist of 25mm depth of dense, well rooted, vigorous grass growth with 25mm depth of topsoil. It should be free from any material toxic to plant growth, declared weeds, seeds or roots including nut grass and oxalis. The soil attached to the turf shall be free from rubbish, sticks and other deleterious material.

8.4.2 The turf shall be supplied as rolls in long lengths of uniform width, not less than 300mm, and shall be in sound unbroken condition.

8.4.3 The moisture level in the cut turf should be kept relatively consistent so that it is not saturated or severely dried out when laying. Both of these situations can cause turf to fall apart during laying.

8.4.4 The type of grass turf to be used shall as stated on the approved Project Drawings, where not stated broad leaf buffalo shall be used for un-irrigated areas and couch for irrigated areas.

8.4.5 Acceptable species for this region are as follows:

- 8.4.5.1 Axonopus compresus (Broad leaf buffalo)
- 8.4.5.2 Digitaria didactyia (Blue Couch)
- 8.4.5.3 Cynodon dactylon (Bermuda Couch / Green Couch).

SG 8.5 Hydromulch

8.5.1 The hydromulching mixture shall consist of the following:

- 8.5.1.1 Mulch - Pulped Paper / Bagasse or Cane fibre
- 8.5.1.2 Fertiliser - Broad spectrum type CK55 or equivalent.
- 8.5.1.3 Seed - 33% Cynodon Dactylon (Green Couch) - hulled 33% Cynodon Dactylon (Green Couch) - unhulled 33% Axonopus Affinis (Carpet Grass)
- 8.5.1.4 Water - Water used to establish and maintain the grassing shall have a pH of between 5.0 and 8.0, a total soluble salts concentration less than 1000mg/l and contain no chemicals or compounds toxic to growth.
- 8.5.1.5 Binder/Tackifier - Binder is to be non-toxic, inert, water soluble and non-flammable, e.g. Curasol or equivalent. Tackifier is be a non-toxic and biodegradable e.g. Envirotack or equivalent.

SG 8.6 Plant Stock

8.6.1 All plant species shall be as detailed on the approved Project Drawings. There shall be no substitution of any species without Council approval.

8.6.2 All palms, trees, shrubs and groundcovers shall be true to name. The root system of each plant shall be conducive to successful transplantation, all specimens shall be free from pests and disease, especially Phytopthera, palm beetle, sooty mould and scale, and all containers shall be free from pernicious weeds.

8.6.3 All plants shall be grown in containers and shall comply with the following minimum size requirements:

- 8.6.3.1 Trees - 25 litre container for street tree planting,
- 8.6.3.2 Trees - 45 litre container for medians, tree guards, traffic islands and roundabouts,
- 8.6.3.3 Single stemmed palms - 45 litre container,
- 8.6.3.4 Clumping Palms - 45 litre container □Shrubs - 200mm container,
- 8.6.3.5 Groundcovers – 140mm container.

8.6.4 Plants shall be watered before transportation to the planting site, and shall be delivered to the site in a covered container. During loading and unloading damage in handling shall be avoided.

8.6.5 Species identified in the following are prohibited from use:

- 8.6.5.1 Land Protection (Pest and Stock Route Management) Act 2002,
- 8.6.5.2 Land Protection (Pest and Stock Route Management) Regulation 2003
- 8.6.5.3 Species identified in the Local governments Pest Management Plans, and
- 8.6.5.4 Publication “Agricultural and Environmental Weeds – Far North Queensland” (Wet Tropics Management Authority and Department of Natural Resources and Mines & Energy)

SG 8.7 Soil Mix

8.7.1 A good quality landscaping soil mix shall be imported from an approved source to the planting site for backfilling the planting pits.

8.7.2 Specification for the landscaping soil mix are as follows:

- 8.7.2.1 It shall contain approximately 70% sandy loam and 30% composted or mature organic matter;
- 8.7.2.2 It shall be friable and not contain any clay;
- 8.7.2.3 The pH shall be between 5.5 and 7.0;
- 8.7.2.4 It shall be free from contaminants such as the seed of declared weeds, rocks sticks and salts;
- 8.7.2.5 It shall not contain any chemical fertilisers.

SG 8.8 Fertiliser

8.5.1 Fertiliser shall confirm to the requirements stated in Table S8.01.

Table 8.01 Fertiliser Types

Location	Chemical Type	Type of Application	NPK Analysis
Grass Seeding (Complete lawn fertiliser)	Inorganic	Surface broadcast	N 15 to 24 P 6 to 9
Turfing (Complete lawn fertiliser)	Inorganic	Surface broadcast	N 15 to 24 P 6 to 9
Tree Planting (Controlled release fertiliser)	Organic or inorganic	Fertiliser Tables (2 per tree)	N 15 to 25 P 3 to 9
Planting Beds (Controlled release fertiliser)	Organic or inorganic	Granular	N 18 to 25 P 3 to 7 K 9 to 18

SG 8.9 Irrigation Pipework

8.9.1 All below ground pipework shall be unplasticised Poly-vinyl Chloride (uPVC) unless otherwise approved. All pipes shall be Class 12 minimum with Class 18 fittings.

8.9.2 All above ground pipe work shall be copper tube (hard drawn) Type D manufactured in accordance with AS 1432 by an Australian Standards quality endorsed company.

Construction

SG 8.10 Grass Seeding

8.10.1 Prior to grass seeding all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.

8.10.2 Prior to grass seeding the ground surface shall be lightly tyned to a depth of 100mm below finished surface levels (where slopes are less than 10%). All large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

8.10.3 Parks may require additional topsoil to a depth of not less than 75mm and shall be lightly compacted and grassed if Council considers the in-situ topsoil of poor quality and is too rocky.

8.10.4 Grass seeding applied by drill seeding at the minimum rate of 50kg per hectare using the species mix specified.

8.10.5 Fertiliser should be applied following seeding at a minimum rate of 350kg per hectare, subject to specific site conditions, soil analysis and desired outcomes.

8.10.6 Seed and fertiliser should be applied at an even rate using a calibrated disc drill seeder followed by a chain and roller.

8.10.7 Disc's should cut approximately 12mm and create enough friable material for chains to cover the seed.

8.10.8 Where one pass fails to develop enough friable material a second pass should be made in a transverse direction.

8.10.9 Watering is the application of 10mm of water to the total area in not less than one hour and shall include any natural rainfall. The frequency of watering shall comply with the following minimum requirements:-

Table 8.02 Grass Seeding Water Requirements

Periods after Grassing	Watering(s)
Immediately	Once
Week 1	Twice / day during hot, dry or windy periods Once / day during cool / overcast periods
Week 2	Once / day
Weeks 3 & 4	Once every second day
Week 5 until necessary	Twice a week or as necessary to ensure 80% minimum strike rate

8.10.10 Acceptance shall be the achievement of a minimum vegetative cover of 80% of both the annual and perennial grass cover over the whole area. Grassed areas shall exhibit signs of healthy growth and shall be free of weeds, stones, sticks and other deleterious material. Maximum deviation from finished ground levels 50mm in any 2 metres.

SG 8.11 Turfing

8.11.1 Prior to turfing all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.

8.11.2 Topsoil shall be uniformly applied to provide an average thickness of 50mm with a minimum compacted thickness of 25mm at any location and graded to even-running contours, so that no ponding or waterlogging occurs across the surface of the grassed area.

8.11.3 The prepared surface shall be watered within twenty four (24) hours prior to turfing at an application rate of 10mm of water in not less than 1 hour. Watering is to be carried out in such a way as not to cause any scouring or erosion.

8.11.4 After watering an approved lawn pesticide shall be applied at the rate specified by the supplier and in accordance with the Agricultural Chemicals Distribution Contract Act and Regulations.

8.11.5 Fertiliser should be applied prior to laying turf at a minimum rate of 350kg per hectare, subject to specific site conditions, soil analysis and desired outcomes.

8.11.6 Topsoil shall be raked before turf is laid. Turf shall be laid in straight lines with staggered cross joints on the general line of the contour of the slope. The gaps between adjacent sections of turf should not exceed 5mm.

8.11.7 A light top dressing shall be worked into the open joints between the turf and then the turf lightly rolled with one pass of a roller weighing about 80kg on a 1m width of roller. Alternative methods to rolling shall be used where slopes exceed 10%.

8.11.8 On steep slopes (exceeding 10%) turf may be held in position by softwood pegs or stakes, located at each end of the turf sections.

8.11.9 Watering is the application of 10mm of water to the total area in not less than one hour and shall include any natural rainfall. The frequency of watering shall comply with the requirements in table 8.03:-

Table 8.03 Turfed Watering Requirements

Periods after Grassing	Watering(s)
Immediately	Once
Week 1	Once every second day
Week 2, 3 & 4	Three times each week
Weeks 5 - 12	Twice a week

8.11.10 Acceptance shall be the achievement of an even green colour with a dense continuous sward over the whole area. Turf shall exhibit signs of healthy growth and shall be free of weeds, stones, sticks and other deleterious material. Maximum deviation from finished ground levels 50mm in any 2 metres.

SG 8.12 Hydromulching

8.12.1 Prior to hydromulching all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.

8.12.2 Batter slopes less than 20% shall then be lightly tyned to a depth of 50mm to produce a loose surface and all large stones, rubbish and other materials that may hinder germination shall be removed before topsoiling.

8.12.3 Where batters have been stepped, the steps shall be loosely filled with topsoil. Elsewhere, topsoil shall be uniformly applied to provide an average thickness of 75mm with a minimum compacted thickness of 40mm at any location.

8.12.4 Dry surfaces shall be watered by a fine spray before the application of the hydromulch.

8.12.5 The slurry mixture of mulch, binder, fertiliser and seed is to be kept in a homogenously mixed state throughout the mulching operation.

8.12.6 During preparation of the hydromulch, a liquid form pesticide may be added to the storage tank, to facilitate surface application. Application rate should be in accordance with the manufacturer's recommendation.

8.12.7 Additional protective treatments (e.g. fibre matting, anionic bitumen emulsion etc) shall be as specified on the approved Project Drawings.

8.12.8 Hydromulch shall not be applied under the following weather conditions at the site:

8.12.8.1 when temperature is higher than 35°C

8.12.8.2 when winds exceed 15 km/hr;

8.12.8.3 where the surface is too wet or

8.12.8.4 during rain periods or when rain appears imminent.

8.12.9 The rate at which the mulch is applied is dependent on slope shall be in accordance with Table S8.02.

Table S8.02 Hydromulching Material and Application Rates (per 1000m)

Slope	<5%	5% - 12%	12% - 20%	20% - 50%	>50%
Pulped Paper	200kg	120kg	120kg	140kg	200kg
Bagasse (wet weight)	200kg	400kg	500kg	700kg	800kg
Cane Fibre (alternative to bagasse)	200kg	200kg	300kg	400kg	500kg
Fertiliser	50kg	50kg	50kg	50kg	50kg
Seed	5kg	5kg	5kg	5kg	5kg
Water	8000 litres	8000 litres	10,000 litres	12,000 litres	18,000 litres
Binder Curasol Envirotack	5 litres 3kg	5 litres 2kg	7.5 Litres 7.6 3kg	15 litres 5 kg	30 litres 5kg
Mulch Thickness	1-2mm	2-3mm	2-4mm	2-4mm	4-6mm

8.12.10 Watering is the application of 10mm of water to the total area in not less than one hour and shall include any natural rainfall. The frequency of watering shall comply with the following minimum requirements:-

Periods after Grassing	Watering(s)
Immediately	Once
Week 1	Twice / day during hot, dry or windy periods Once / day during cool / overcast periods

Week 2	Once / day
Weeks 3 & 4	Once every second day
Week 5 until necessary	Twice a week or as necessary to ensure 80% minimum strike rate

8.12.11 A follow up fertiliser treatment is to be applied to 4 – 6 weeks after germination has occurred. Fertilisation should be with a product that provides for the following elements: Nitrogen (N) 13%, Phosphorus (P) 4% and Potassium (K) 12%.

8.12.12 Acceptance shall be subject to the achievement of a minimum vegetative cover of 80% of both the annual and perennial grass cover over the whole area. Hydromulched areas shall exhibit signs of healthy growth and shall be free of weeds, stones, sticks and other deleterious material.

SG 8.13 Planting

8.13.1 Planting shall be carried out as soon after delivery to the site as possible. All containers, unless fully biodegradable, shall be removed at the latest point before planting.

8.13.2 All plants shall be obtained from a nursery located in an area having a similar climate to the site of the Works.

8.13.3 Shrub and ground cover planting to verges and traffic islands etc. shall be as detailed on the approved Project Drawings.

8.13.4 Prior to planting all weeds shall be killed by spraying a suitable herbicide. Sprayed areas shall remain undisturbed for two weeks.

8.13.5 Street trees shall be planted at the locations as shown on the approved Project Drawings.

8.13.6 During backfilling around the plants the soil shall be lightly firmed to ensure intimate contact with the roots, but with large material successive layers of soil will need to be firmed as backfilling proceeds.

8.13.7 Ensure the plants are held securely by the soil but not so that moisture penetration of the soil is restricted. After planting, damaged, dead, diseased or crossing branches shall be removed by pruning.

8.13.8 Plants should be watered directly after planting prior to spreading of mulch. The mulch shall be left just clear of the plant stem.

8.13.9 All trees shall be staked with three (3) 38 x 38 x 2400mm hardwood stake, extending into the ground to a depth of 500mm. Do not allow the stake to penetrate the root ball. Secure the tree to the stake with plastic multi-purpose chain ties. Refer Council's Standard Drawings.

8.13.10 Mulch shall be aged hardwood woodchip, stockpiled for a minimum of 6 weeks, or other mulch approved by Council, free from rocks, non-biodegradable and toxic material. In paved footpath planters it shall be installed to a depth of 75mm, in tree guards, traffic islands and mulched, mass planted garden beds within parkland and reserves to a depth of 150mm depth.

8.13.11 Peanut shell or forest litter mulch may be used in "natural" planting areas only, such as buffer planting or parkland planting. It should be installed to a minimum 150mm compacted depth, free from rocks, nut grass, and any other invasive weed.

8.13.12 Tea-tree mulch is prone to combustion and shall not be used unless permission is obtained from Council.

8.13.13 All plants shall be watered, immediately upon planting, and at the rate of 10 litres per plant every third day for the first twelve weeks.

8.13.14 Weed and grass growth in mulched areas shall be killed by treatment with herbicide in accordance with the manufacturer's instructions at monthly intervals during the construction period and contract maintenance period. Contact of the herbicide with the new plants shall be avoided and any damage repaired, or damaged plant material replaced.

8.13.15 Acceptance shall be subject to achieving the following criteria:

8.13.15.1 Plants, which do not meet the acceptance criteria, shall be replaced.

8.13.15.2 Replacement plants shall be of similar size and quality and of identical species and variety to the plant being replaced.

8.13.15.3 Plants shall exhibit signs of healthy growth,

8.13.15.4 Plants shall be well formed,

8.13.15.5 Plants shall be free from disease or insect pests,

8.13.15.6 Plants shall be free of physiological disease symptoms (yellowing, wilting etc),

8.13.15.7 Mulch shall be free from weeds, sticks, rubbish and other deleterious material.

Irrigation

SG 8.14 General

8.14.1 Application shall be made to Council for connection of irrigation systems to the water main. The Contractor shall arrange with the Council for the timing of the work. All works shall be carried out by the relevant Local Authority at the applicants cost.

8.14.2 The Applicant will be responsible for the payment of all water used during construction, testing, establishment and maintenance of the irrigation system and landscape works.

SG 8.15 Excavation

8.15.1 Do not excavate by machine within 500mm of existing underground services.
8.15.2 The standard width of trench for pipes shall be 150mm.
8.15.3 Unless noted otherwise on the approved Project Drawings or directed by Council all pipe work is to be installed with a minimum cover of 350mm.

SG 8.16 Laying of Pipes

8.16.1 All pipe work to be bedded in clean fill sand with a minimum cover of 50mm all round.
8.16.2 Special precautions are to be taken to exclude dirt, sand, grit or gravel from entering pipelines.
8.16.3 The open ends of pipes shall be plugged at the end of the day's work to prevent entry of water or mud.

SG 8.17 Pressure Testing

8.17.1 All work shall satisfy a test pressure of the nominated working pressure for a period of two (2) hours. The test shall be carried out during the coolest part of the day. The point at which the test pressure is measured shall be at the lowest point in the profile of that section of main under test.
8.17.2 All tests shall be carried out under the supervision and in the presence of the Council Inspector.
8.17.3 Any defects that arise during the tests shall be repaired in an approved manner. Any leak however small will be classed as a defect. All such repair work shall be similarly tested and approved before acceptance.
8.17.4 The Contractor shall give 48 hours notice to Council so that arrangements can be made for supervision of the testing.
8.17.5 The Contractor shall accept all risks and expenses incurred during testing and shall provide all labour together with all pumps, engines, pipes, temporary valve plugs, flanges and all other equipment as may be necessary to undertake testing

SG 8.18 Flushing

8.18.1 After pressure testing has been carried out the new pipework shall be flushed as thoroughly as possible with the available water pressure.

SG 8.19 Controllers

8.19.1 All Council landscaped areas, which require irrigation systems shall be controlled by electrically, operated solid state controller.

SG 8.20 Filtration

8.20.1 All irrigation systems shall be fitted with an approved flow strainer installed in a secure enclosure.

SG 8.21 Valves

8.21.1 Electrically actuated solenoid valves shall have flow control, manual bleed screw, 24 VAC solenoid, Buna N diaphragm, and be constructed of PVC and stainless steel. They shall be suitable for direct burial and have 150 psi maximum working pressure. They shall be pressure regulating solenoid valves.

8.21.2 Isolation valves shall be of bronze construction and of the BSP screwed gate type as approved by the engineer. They shall be installed on the supply side at every solenoid valve to enable isolating.

8.21.3 Protective valve boxes are to be provided for each solenoid valve. They shall be constructed of green high density polyethylene, be 450 x 300 x 300mm in dimension, and have a lockable lid with the word "Irrigation" clearly marked on it.

8.21.4 The wiring from the solenoid to the controller shall be laid in conduit and shall be of 250 volt grade and shall be installed to approved standards. The wiring shall be located with all pipework.

8.21.5 All solenoid valves shall be connected to controller by 0.05mm solid core wire and to have seven insulated cores within a common plastic protective shield. It shall be similar in all respects to RIS multi-core 7/0.5mm electrical control wire and shall be continuous between valve and controller, and valve to valve. An additional one metre length of cable shall be provided at each wire termination. Cable shall be sized for voltage drop not exceeding four (4) volts over total route length.

SG 8.22 Backflow Prevention Devices

8.22.1 All Council landscaped areas, which require irrigation systems, shall have a backflow prevention device installed. This device should comprise of a stand constructed fully from hard drawn copper pipe (Type D) and should have an inline strainer both before and after the backflow preventer. This should comply with AS 2845.

SG 8.23 Performance Test

8.23.1 On completion of the installation the system shall be tested in the presence of a Council Inspector.

8.23.2 The system shall be operated to demonstrate that all components function as required by the design.

8.23.3 The Contractor is responsible for making all necessary alterations to the system so that the performance is in accordance with the design specifications.

SG 8.24 Backfilling of Trenches

8.24.1 Trenches shall be backfilled with the excavated material. If the excavated material is considered unsuitable for backfilling by the Council Inspector, it shall be removed from the site and replaced with clean approved backfill material.

8.24.2 All trenches so backfilled shall be compacted and lightly raked to ensure that surface levels marry with adjacent surface levels, are free draining and free from mounds or depressions. All rocks or evidence or excavated subgrade shall be raked up and removed.

Form 1 - Statement of Compliance Operational Works Design

This form duly completed and signed by an authorised agent of the designer shall be submitted with the operational works application to Council approval.

Name of Development:

Location of Development:

Applicant:

Designer:

it is hereby certified that the calculations, drawings, specifications and related documents submitted herewith have been prepared, checked and amended in accordance with the requirements of the Whitsunday Regional Council Development Manual and that the completed works comply with the requirements therein, except as noted below.

Compliance with the requirements of the Operational Works Design Guidelines	Non-compliance - refer to non-compliance report/drawing number
Plan presentation	
Geotechnical requirements	
Geometric road design	
Pavements	
Structures/bridges	
Subsurface drainage	
Stormwater drainage	
Site regrading	
Erosion control and stormwater management	
Pest plant management	
Cycleways/pathways	
Landscaping	
Water source and disinfection/treatment infrastructure	
Water reticulation pump stations	
Sewer reticulation and pump stations	
Electrical reticulation and street lighting	
Public transport	
Associated documentation/specification	
Priced schedule of quantities	
Referral agency conditions	
Supporting information (AP 1.08)	
Other	

Designer: RPEQ No.

Signature: Date:

Form 2 – Security Lodgement Form
This sheet must be completed prior to the acceptance of any bond by Council.

Development Name:	
Stage:	
File No.:	
Applicant:	
Consultant:	
Purpose of Bond:	

Uncompleted Works Bond Assessment:

Estimated time to complete bond works (not greater than 90 days)	days
Current contract completion date	
Anticipated completion date	
Consulting engineers estimated value of uncompleted works	
Bond value (apply factor 1.50)	

Construction/defects liability bond assessment :

Consulting engineer's estimated value of completed works	
Construction/maintenance bond value (apply factor 0.05) (min $500)	

Council shall retain any interest accrued on cash monies paid to Council and held in trust by Council.

Consulting Engineer:

Signature:

RPEQ No.

Date:

Form 3 – Inspection Certificate for Witness/Hold Point

This certificate registers evidence that the works as noted herein have been inspected by the Council officer noted below and were found to be satisfactory.

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Contractor:	

Works being inspected/Tested/Witnessed:

Defaults/Corrective Action Required:

Defaults Corrected?	Y	N	N/A

Council Inspector Signature:

Name of Inspector:

Date of Inspection:

Form 4 – Works Acceptance Inspection Checklist

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Contractor:	

Item	Verification (Yes/No/N/A)	Comment
ALLOTMENT DRAINAGE The works have been finally inspected and:		
60. Concrete catch drains constructed in approved location and to a satisfactory standard;		
61. Field inlets constructed in approved location and to a satisfactory standard;		
62. Overland flow path constructed to correct profile;		
63. Pipework has been visually inspected and is satisfactory in terms of: a. alignment and grade; b. free of debris and siltation; c. no visual sign of trench subsidence; and d. outlets are satisfactory.		
64. Lots not provided with allotment drainage can be drained to the kerb and channel.		
STORMWATER DRAINAGE SYSTEM The works have been finally inspected and:		
65. Pipe layout is as per plan or approved amendments with respect to pipe size, levels and location.		

66. Pipework has been visually inspected and is satisfactory in terms of: a. alignment and grade; b. free of debris and siltation; c. lifting plug holes sealed; d. no visible sign of trench subsidence; and e. no damaged pipes.		
67. Gully pits and manholes have been constructed to the correct standards i.e.: a. Correct type of grate or cover; b. Lintels; c. side entry slots; d. benching (no water ponding) e. grates are satisfactorily sealed in frames; f. we poles provided to bedding material; g. no damaged structures; h. converter slabs/sections mortar bedded; i. correct drops through gullies/manholes; and j. all lids/grates finished to match surface level.		
68. All density tests to backfill are available and satisfactory.		
69. Material gradings are available for bedding material and are satisfactory;		
70. Outlets/inlet structures are satisfactorily constructed and are free from scour or siltation.		
71. All manhole and gully pit pipe connections are mortared flush with the walls and no pipe reinforcement is exposed.		
72. Open cut channels have been finally inspected and a satisfactory i.e.: a. Cut to design profiles; and		

b. lining of channel is to the required thickness and reinforcement, with appropriate weep holes.		
73. Overland flow, the works have been finally inspected an appropriate flow paths are provided and clear of obstruction.		
74. Outlets and outfalls have been constructed to control discharge flow in accordance with the plans.		
75. Subsoil drainage discharges to gullies or other approved point of discharge.		
76. All grousing requirements to channels, swales, outlets, inlets etc have been completed.		
77. CCTV inspection of stormwater pipes completed.		
WATER QUALITY The Works have been finally inspected and:		
78. Water quality structures have been constructed in accordance with approved engineering drawings;		
79. Structures are free of debris and sediment.		
EROSION AND SEDIMENT CONTROL The works have been finally inspected and:		
80. Control structures required until the site is stabilised in accordance with the contractor's ESCP are in place.		
81. Structures are free of debris and sediment.		
EARTHWORKS		

The Works have been finally inspected and:		
82. Toe of batters not on Council Road reserve except as approved.		
83. Retaining walls clear of Road reserve except as approved.		
84. Retaining walls constructed in accordance with drawings.		
85. Batter slopes constructed in accordance with drawings.		
86. Batter slopes stabilised against erosion.		
87. Interim drainage constructed in accordance with drawings.		
88. All areas disturbed by the works have been rehabilitated.		
89. Allotment levels are as per the design plans.		
90. Verge levels are as per the design plans.		
SEWER RETICULATION The Works have been finally inspected and:		
91. Pipe layout is as per the plan or approved amendments with respect to pipe size, levels, and location.		
92. Pipework has been visually inspected and is considered satisfactory, i.e.: a. Pipework flush with internal walls of manhole; b. alignment and grade; c. flexible joints; d. line flushed and cleaned; e. no visible sign of trench subsidence; f. a density test of backfill is available and satisfactory;		

g. CCTV survey results submitted and satisfactory.		
93. Manholes and maintenance shafts have been constructed to the correct standards, i.e.: a. Cast in situ; b. Benching; c. curvature satisfactory; d. no ponding; e. profile satisfactory; f. no weeps (free of infiltration); g. concrete work; h. no honey combing; i. covers; j. covers checked to be gas tight; k. correct type; l. imprint in accordance with standards; m. depth of cover surround; n. depth of top slab; o. location; p. relative to allotment boundaries; and q. 50 to 75 mm proud of finished surface level.		
94. Material gradings for bedding material are available and satisfactory.		
95. Pressure test results are available and satisfactory.		
96. Manhole hydrostatic test all satisfactory.		
97. Sewerage connection Private Works fees paid.		
98. On-site sewer report provided (if applicable).		
99. PUMP STATION - refer separate PS checklist.		
WATER RETICULATION The works have been finally inspected and:		

100. Pipe layout and services fixtures (valves and hydrants) are as per the plan or approved amendments with respect to pipe size and location.		
101. Pipework has been pressure tested in accordance with Council's requirements and test results are available and satisfactory.		
102. Pipework has been chlorinated in accordance with Council's requirements.		
103. There are no visible signs of trench subsidence for leaks.		
104. Valves and hydrants have been inspected and a satisfactory, i.e.; a. Location; b. setts and surrounds correctly installed to prevent ingress of soil, etc; c. mortar packing to boxes correctly completed; d. depth to top of hydrant or valve stem within limits; e. dust caps to hydrants; f. colour of marker plate correct; g. direction of flow indicated; h. marking plates correctly installed; and i. size of plate correct.		
105. Material gradings for bedding material are available and satisfactory.		
106. Water supply connection Private Works fees paid.		
107. PUMP STATION - refer separate checklist.		
ROAD PAVEMENTS The works have been finally inspected and:		

108. Plan layout and geometry of Road system is in accordance with the drawings.		
109. Finish levels at Crown and channel are at design levels.		
110. Cross falls are to the approved plan.		
111. AC is satisfactory with regards to finish and thickness.		
112. Joints in the seal (especially where various development stages apply) are flush.		
113. The sealed surface is free of blemishes.		
114. All compaction test, material quality (CBR), material grading, AC core tests are satisfactory and available.		
115. Ponding of stormwater does not occur.		
SEGMENTAL PAVERS (Where Constructed) The Works have been finally inspected and:		
116. All pavers have been correctly laid to pattern, within allowable tolerance, compacted, and the joints filled;		
117. Bedding sand for pavers drains to subsoil drainage.		
118. Pavers adjacent to concrete kerb and channel, edge restraints etc have been cut and laid in accordance with all relevant requirements.		

Form 5 – Registered Engineer's Certification of "As Constructed" Works

This certificate registers evidence that the locations, surface and invert levels of all works and infrastructure presented on the drawings noted below and in the digital ADAC data have been surveyed and meet the accuracy standards as defined within the WRC Development Manual.

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Contractor:	
Surveyor Name:	
Surveyor Firm:	

Drawings & Documents pertaining to the above:

Signed:

Date:

Form 6 – Registered Surveyor's Certification of "As Constructed" Works

This certificate registers evidence that the "As Constructed" drawings submitted herewith have been prepare, checked and amended in accordance with the requirements of the WRC Development Manual and that the completed works comply with the requirements therein.

Development Name:	
Development Location:	
File No.:	
Consulting Engineer:	
Consulting Firm:	
Surveyor Name:	
Surveyor Firm:	

Certification by Registered Surveyor (Consulting) attached: Yes / No

(Note: Certification is to be in accordance with the Development Manual).

Compliance with the manual Design Intent and Function not compromised by the "As Constructed" Works	**Compliance Yes/No**	**Non-Compliance refer to attached redesign of works to ensure satisfactory performance**
Earthworks		
Roadworks		
Stormwater Drainage		
• Flow System and Structures		
• Major Flow System and Structures		
Water Reticulation		
Sewerage Reticulation		
"As Constructed" Documentation		

Signed:

RPEQ No.

Date: