Technical Guideline for Infrastructure Design

Version 1 – September 2024

For use on all infrastructure that is designed for or inherited by the City of Coffs Harbour

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PART 1

GENERAL

REQUIREMENTS

1. General requirements

1.1 Introduction

The Technical Guideline for Infrastructure Design has been compiled to outline the City's general procedures and practices for the engineering design requirements of new infrastructure associated with the subdivision and development of land within the City area. It is also applicable to new infrastructure design undertaken by or on behalf of the City.

The following Technical Guidelines have been prepared to ensure design consistency across City infrastructure and to facilitate the expedient processing of engineering plan submissions, issue of Construction Certificates and release of Subdivision Certificates. Applicants should be aware that each development is required to be treated on its merits and that approval is dependent on the overall impact of the development on the area and not solely in compliance with these guidelines.

The City welcomes the submission of innovative design solutions and staff are available for initial consultation to discuss and assess the prospects for approval.

Any proposed departures from these standards are to be submitted to the City prior to submitting non-conforming plans in accordance with the Design departures section of this document. Any application for a departure from the Technical Guidelines is to include details of alternative options considered and reasons these alternatives are not suitable. Reduction in lot yield alone will not be sufficient reason for non-conformance with the Technical Guidelines.

Applicants are advised to ensure that all conditions of the Development Consent are addressed within the detailed engineering plans.

Part 1 of the Technical Guideline outlines the City's general engineering requirements. The detailed engineering design requirements are given in Parts 2 to 7.

Part 2 Technical Guideline for Design of Roads

Part 3 Technical Guideline for Design of Stormwater Drainage and WSUD

Part 4 Technical Guideline of Water Reticulation

Part 5 Technical Guideline of Wastewater Reticulation

Part 6 Technical Guideline for Landscaping

Part 7 Technical Guideline for Bulk Earthworks and Retaining Walls

1.2 General

It is important to recognise that where a developer proposes or is required to carry out civil engineering works in connection with a subdivision or development, the civil engineering works will generally become the responsibility of the City for ongoing asset management.

Before the developer commences the civil engineering works, a satisfactory engineering plan of the proposals should be submitted to and approved by the City.

When approval to a subdivision or other development includes conditions of construction which are embodied in the approved plans and specifications, the onus is primarily on the applicant to whom the approval is given to ensure that the work is completed in accordance with plans and specifications.

A contractor carrying out subdivision works is responsible to the developer, not the City.

The developer should nominate to the City, the person or firm with whom correspondence relating to the technical aspects of the development should be exchanged.

The City will hold the developer (applicant), to whom the development approval was issued, solely responsible for constructing the required development works to the City's satisfaction and maintaining them during any specified period.

The developer should nominate to the City for approval prior to commencement of construction, the name of the contractor who is to carry out the work associated with the development. Details of experience and technical expertise in similar works and the financial capabilities of the contractor to carry out the works are also required by the City.

The City will not require the details above for contractors previously approved.

1.3 Definitions

Developer: Any reference to Developer in all sections of this Technical Guideline will be taken as the Owner(s) and or Financial Contributor(s) of the proposed works.

Developers Representative: Any reference to Developers Representative in all sections of this Technical Guideline will be taken as any company or person(s), acting for or on behalf of the Developer. This includes but is not limited to designers, civil contractors, planners and other persons engaged by the Developer.

Engineer: A person with a qualification from an accredited program listed as acceptable for Membership of The Institution of Engineers Australia, a person who has been assessed as meeting the Stage 1 Competency Standard as assessed by Engineers Australia or a person with equivalent qualifications and experience and is deemed to be suitably experienced by the City.

Footway: Refers to the verge area between the edge of pavement and property boundary, which is used for services, street trees and footpaths.

Group Lead: Any reference to Group lead in Parts 2, 3, 4 ,5, 6 and 7 will be taken as a reference to the Group Lead of the respective asset or their nominated representative.

LGA: Refer to the Local Government Area

Registered Surveyor: A person registered under the Surveying and Spatial Information Act, 2002.

Technical Guideline: Any reference to Technical Guideline or Technical Guideline for Infrastructure Design in this document shall be taken as a reference to this document being "Coffs Harbour Technical Guideline for Infrastructure Design".

The City: Any reference to the City refers to the City of Coffs Harbour, which is the Local Government authority for the Local Government Area.

Superintendent: A suitably qualified engineer with suitable experience in the supervision of such works who is not engaged by or have financial interest in the contractor undertaking the works

1.4 Changes to the technical guideline for infrastructure design

The City will make updates to this Technical Guideline as required. A current copy of the Technical Guideline will be available at www.coffsharbour.nsw.gov.au. It is the responsibility of the Developer to ensure that all aspects of submitted drawings comply with the most current version of the Technical Guideline as at the date the final designs have been submitted for assessment. Changes to this Technical Guideline are recorded in Part 8 Document history and changelog of this document for transparency.

1.5 Submission of engineering drawings and specifications

All documentation supporting relevant certificate or consent that is being applied for including a Construction Certificate, Civil Works Certificate or Subdivision Works Certificate application must be submitted in electronic format. Subdivision Works Certificate applications shall be applied for through the New South Wales Planning Portal.

The documentation supporting a such Certificate applications must be complete in its entirety and satisfy all requirements of the consent, the City's Technical Guideline for Infrastructure Design and the City's Development Control Plan.

The covering letter shall detail the contents supplied in the electronic media and if applicable the number of lots included in the application. The fee payable shall be in accordance with the City's current Fees and Charges plan at the time of application.

It is the responsibility of the consultant/engineer engaged by the Developer to ensure that the engineering survey supporting the design detail and drawings is of sufficient quality and accuracy to support the design of all infrastructure and land features encompassed by the works.

Designs submitted to the City containing errors or omissions that may have a significant impact on the final design will require resubmission. No further review will be undertaken by the City staff once such an error or omission is identified. e.g. plans submitted without sewer long sections.

Repeated submission of substandard drawings may incur additional assessment fees and necessitate in a meeting between the City staff, the Developer and the Developers Representative to resolve outstanding issues.

1.5.1 Engineering Drawings

Engineering drawings are to be submitted in, as a complete set in accordance with Table 1-A with a covering letter, by the applicant. One (1) set of approved plans in digital format will be returned to the applicant.

Inspection and Test Plans (ITPs), Engineering Checklists, Annexure A – Certification and copies of relevant Insurances must be supplied with the drawings.

Specific requirements to be included on drawings are detailed in checklists in each part of the Technical Guideline to ensure the necessary information is provided on the drawings.

All drawings should be signed by the respective consultant/engineer engaged by the Developer.

The City email address shall be copied in on any electronic submissions to the City as per the address: coffs.council@chcc.nsw.gov.au

Engineering drawings that are completed by a consultant on behalf of the City (i.e. the consultant is engaged by the City), shall incorporate a section in the title block for an approval signature by the City's delegated representative. The title block shall include space for the position (SECTION LEAD ASSET SERVICES), the date and signature.

Table 1-A Plan submission requirements

Type	Revision	Submission Requirements	Notes
		Electronic	
SWC/CW	Initial Revision submitted to the City	PDF - Complete Plan Set Associated model files PDF - Pavement Design Report PDF - Line Marking & Signage Plan Safety in Design Report PDF – Inspection Test Plan	
	Subsequent Revision(s)	Any requested revised or additional information	Inspection Test Plan only required where resubmission is requested by the City
	Final Revision for Stamping and issue of relevant Certificate	PDF - Consolidated set of final plans and reports	
WAE	Initial Revision *(Revision "W1" – Notation "Works As Executed for the City Approval")*	PDF - Complete Plan Set (marked-up) PDF - Quality Assurance Documents DWG Associated model files of WAE Stormwater System where requested	Operations and Maintenance Manuals only where applicable
	Subsequent Revision(s) *(Revision "X")*	PDF - Complete Plan Set (marked-up) PDF - Quality Assurance Documents DWG	
	Final Revision *(Notation – "Approved Works as Executed")*	PDF - Complete Plan Set (marked-up) PDF - Quality Assurance Documents DWG	

- **Complete Plan Set** – All sheets in plan set regardless of whether the sheet has been revised or marked-up since previous submission
- **Quality Assurance Documents** – Copies of all testing results, completed inspection test plans, required certification documentation and conformance surveys.

1.5.2 Safety In Design reports

A Safety in Design report prepared in accordance with the Work Health and Safety (WHS) Act 2011 shall be submitted with the initial revision of the design plans and prior to the issue of the relevant Certificate or consent. The Developers Representative engaged in the preparation of plans and administration of construction works must ensure that all engineering structures are designed without risks to the health and safety of persons. The report should address all 'structures' as defined in the Work Health and Safety (WHS) Regulation 2017.

The Safety In Design Report must specify but is not limited to:

- The hazards relating to the structure;
- The risks associated with the hazards;
- An initial risk assessment of the hazard;
- Control measures to reduce the risks as appropriate; and
- A residual risk assessment of the hazard.

The report shall identify the risks and control measures across the whole life including construction, operation, maintenance and demolition.

1.5.3 Persons qualified

The City requires that design plans be prepared to the City's standards by either:

- A person with a qualification from an accredited program listed as acceptable for Membership of The Institution of Engineers Australia;
- A person who has been assessed as meeting the Stage 1 Competency Standard as assessed by Engineers Australia; or
- A person with equivalent qualifications and experience in the preparation of plans and specifications for land development.

The City relies upon the professional skill and experience of the person responsible for the preparation of the plans and specifications for the land development. The City requires that the person taking responsibility for the proper design and specification for the land development (or each of them when there is more than one) provide a certificate in the form attached to this Technical Guideline (as ANNEXURE A – Certification**)** certifying that all prudent actions have been taken to ensure that the design meets or exceeds current engineering standards appropriate to the development and the site.

1.5.4 Construction specification

The plans prepared in accordance with this Technical Guideline shall be constructed in accordance with The City of Coffs Harbour Construction Specifications, which are based on the AUS-SPEC suite of specifications.

1.5.5 Approval of engineering drawings and specification

It is the entire responsibility of the person(s) or company submitting the documents, to ensure that the designs and specification comply with the City's Technical Guideline for Infrastructure Design, as well as the relevant Austroads Guidelines, Australian Standards and local, state and federal government legislation.

The City's issue of the relevant Certificate is conditional on the above basis and does not relieve the developer from rectifying any errors or omissions which become evident during construction.

Developers should be aware that the review of plans and specifications by the City does not extend to verifying site investigations or engineering calculations and design. Professional responsibility for this work rests with the developer and the person preparing the designs and specifications. The City relies upon this work being undertaken by an appropriately skilled and experienced person which must be certified in the manner described in ANNEXURE A – Certification before the relevant Certificate will be issued.

1.6 Design departures

Departures from these guidelines will only be granted by the Group Lead of the relevant Directorate of the City in exceptional circumstances and only after all other avenues to comply with this guideline have been considered and exhausted. Applications for any departures must be lodged at the time of Development Application (DA) or relevant Certificate lodgement. In the event a departure is proposed during construction, application for a departure will be required at that time and determined prior to any departure being constructed.

1.6.1 Application

Application forms are available on the City's website and available as ANNEXURE B – Departure application documents in Part 1 of this guideline. The application must show reasonable grounds for the departure including exploration and assessment of all possible alternatives.

Application needs to be lodged at the same time as the Development Application or SWC.

The submission shall include:

1. Application form Signed in PDF format;
2. Signed Checklist completed in PDF format;
3. Supporting documentation for assessment of the proposal including assessment of alternative options completed and attached;
4. Evidence showing cross discipline checks have been conducted for impacts on other design components including electrical, telecommunications, gas, water, sewer, drainage, planning, and transport;
5. Any other items deemed necessary to support the application; and
6. Letter of outcome in word format pre-populated with application details.

1.7 Release of subdivision certificate

1.7.1 General requirements

The Subdivision Certificate will not be signed and released by the City until it is satisfied that the following has been complied with:

- All maintenance documentation has been submitted and accepted;
- A successful on maintenance inspection has been undertaken with the City's representative(s) including the acceptance of any remedial works;
- 80% stable site cover and rehabilitation of all areas disturbed by the works, which is defined as either grass coverage or the appropriate erosion and sedimentation control measures to the site;
- All relevant bonds have been submitted and accepted; and
- Power supply and street lighting have been energised.

1.7.2 Maintenance documentation

When the Developer or the Developers Representative is of the opinion that completion of works has been reached Developer shall:

- Provide certification prepared by a suitably qualified and experienced engineer confirming that all aspects of the works have been completed to the standard appropriate for acceptance by the City;

- Notify the City in writing for a request of a final inspection;
- Submit preliminary Work As Executed drawings;
- Propose relevant bond amounts and provide supporting bill of quantities; and
- Provide a high-definition Closed Circuit Television (CCTV) recording of all stormwater pipes including inter allotment drainage to clearly display all joints (full surrounds) and any form of damage of defects. The recording is to include a report signed by a suitably qualified and experienced engineer stating that the recording has been reviewed and all works are satisfactory. Where defects have been identified, consultant is to provide method of rectification to the City for approval, prior to carrying out any rectification works.

Within fourteen (14) days of the receipt of the request and associated documentation, the City's Representative(s) shall inspect the works and provide a written advice of the results of the final inspection. The Developer or its nominated representative may be required to be present for the inspection and assist the City's representatives in checking levels, opening manholes etc, as required.

1.7.3 Performance bonds

A performance bond may be lodged by the developer for specified outstanding works, subject to agreement to the extent of those works by the City. The Performance Bond must be lodged prior to the release of the Subdivision Certificate and it shall be the greater of $5,000 or 150% of the value of the outstanding works.

The developer is to provide a detailed costing for the outstanding works accompanied with a timeframe for the completion of the outstanding works not exceeding a time period of 4 years for bio-retention works and 12 months for all other works from the date of release of the Subdivision Certificate. If works are incomplete in the time nominated, the City may complete works at the developer's cost using the bond. Any unexpended balance will be refunded to the developer at the time the works have been completed.

Performance bonds shall not have an expiry date.

Performance bonds will only be accepted for works within a road reserve or drainage reserve and will not be accepted for essential infrastructure such as water and sewer servicing or on future private land.

A maintenance bond shall be paid when performance bonded works are completed.

1.7.4 Maintenance bond and period

Prior to the issue of a Subdivision Certificate or if indicated in a development consent, the City will require the lodgement of a maintenance bond which is held to cover the cost of any maintenance items or defects identified during the maintenance period.

Maintenance bonds shall be:

a. For living landscaping including trees and turf that has been constructed as bonded works; the Maintenance Bond shall be 100% of the cost of these works;
b. For new street trees as of 1 January 2024 $1,100.00 per tree subject to indexation at CPI/Sydney; and
c. Unless specified otherwise all other works which will become the responsibility of the City for ongoing asset management the amount of the bond is calculated as 5% of the total contract price for completion of the work. With a minimum amount of five thousand dollars ($5,000).

The City will not accept Bank Guarantees that have termination or expiry dates. All lodged bonds shall be unconditional.

The maintenance period commences from either date of issue of the Subdivision Certificate or Occupation Certificate, or if neither of these activities are relevant from the date of accepted completion of the works by the relevant Group Lead.

Should a performance bond for outstanding work have been entered into the maintenance period for such work shall commence from the date of accepted completion of the outstanding works by the Group Lead.

The maintenance period for civil works shall be 12 months, unless otherwise stated in a condition of consent. The city will not consider accepting individual elements separately. Where infrastructure is constructed and intended to be a public asset dedicated to the City but staged release of Lots is proposed as part of the Subdivision Certificate process, the city shall only accept civil works including the commencement of the relevant maintenance period associated with the subdivision certificate irrespective of when the works were constructed.

The maintenance bond shall be released upon completion of the maintenance period a satisfactory inspection of the works deemed by the relevant Group Lead. The City shall accept all the works (excepting works subject to extended maintenance periods) off maintenance on the same date. The City will not consider accepting individual elements of the works separately.

Street trees shall be maintained for twelve (12) months in accordance with the City's Street Tree Masterplan to ensure successful establishment and development. A bond per tree is to be paid to the City **prior to the issue of Subdivision Certificate** for the relevant stage. The bond will be returned at the end of the twelve month maintenance period provided that plantings have been established successfully.

Where the health of a plant has deteriorated to the point it requires replanting, the developer has two options with the adopted options to be mutually agreed between the City and the developer. The options include:

- The developer replaces the tree at their own cost and provides a new maintenance bond of $1,100 per tree subject to indexation at CPI/Sydney as of 1 January 2024 for a period of 12 months; or
- The city undertakes the work at a cost of $1,700 per tree subject to indexation at CPI/Sydney as of 1 January 2024 and there is no new maintenance period imposed on the developer. Payment of these costs shall be made prior to the release of the maintenance bond.

1.7.4.1 *Maintenance of works*

The developer's representative must inspect the works for defects at least once every 3 months during the maintenance period. During the maintenance period, any defects which are both evident and directly attributable to any cause (including design, workmanship or materials) from the developer's works are to be remedied by the developer in the manner directed by the relevant Group Lead. Any direction to undertake remedial works will indicate in what respect the works are defective and the date by which the necessary remedial works must be completed. Where it becomes necessary for remedial works to be undertaken during the maintenance period, a separate maintenance period of 12 months, commencing on the date on which the remedial work is accepted by the relevant Group Lead, will apply to those remedial works unless otherwise approved by the Group Lead.

If any defect is not remedied within the time specified by relevant Group Lead in either a written direction to undertake remedial works or a subsequent agreement between that representative and the developer's representative, or the nature of the defects such as a water or sewer main break necessitate immediate action by the City, the City may remedy the defect at the developer's risk and expense, without prejudice to any other rights which the City may have against the developer in respect of that defect. The City may use the maintenance bond to pay the costs and expenses incurred by it in undertaking the remedial work and any shortfall may be recovered from the developer as a debt payable on demand. Until any shortfall is paid in full, it will remain a charge upon the land.

1.8 Works-As-Executed (WAE) plans

Following the completion of engineering works in a subdivision or development, "Works-As-Executed" plans are required to be certified by a registered surveyor/engineer and forwarded to the City prior to the release of the final plan of subdivision or occupational certificate.

The following certificate is to be appended to each page of the plans and signed by the supervising surveyor or engineer.

'I hereby certify that engineering works shown on this plan are Works-As-Executed and have been constructed in accordance with the plans and specifications approved by the City.' I acknowledge the constructed information contained on this drawing may be relied on by the City and others.

Name: _____

Signature: _____

Capacity: _____

Registration Number: _____

Date: _____

The City relies upon the professional skill and experience of the person responsible for the supervision of the works and ensuring the works are undertaken in accordance with the approved plans and specifications together with this Technical Guideline and any other appropriate standards.

Developers should be aware that the City inspections of the site are not a substitute for proper works supervision and the City relies upon the skill, experience and diligence of the person accepting professional responsibility for this work to ensure it is constructed in a proper manner.

1.8.1 General requirements

General requirements regardless of the format Works as Executed drawings are submitted include;

- All sheets in an approved set of plans (the "Complete Plan Set") must be submitted;
- All plans should substantially be in black and white or greyscale;
- There must be a clear delineation of the extent of works, including clear notation of any work that has been constructed in a previous stage or is proposed to be constructed in a future stage;
- The lot layout on the WAE plans should be the same as the layout to be included on the subdivision plan;
- All proposed easements including existing easements to remain must be shown;

- Where new roads are constructed, the approved street names must be included on the plans, either in a tabular format (referencing the approved street name and the name used on the plans) on a general layout plan or road plan or indicated on each plan;
- Constructed pavement designs must be shown;
- The location of all City infrastructure constructed should be included on the plans; this includes but is not limited to conduits, subsoil lines, sewer mains, sewer property branch, water mains, water meters, stub mains and inter-allotment drainage lines;
- The location of temporary turning heads shall be shown;
- The revision detail for each sheet (regardless of whether the sheet contains WAE mark-up or not) shall be noted as follows:
    - Initial Submission must be marked as Revision "X" with the notation "Works as Executed for City Approval" and dated;
    - Subsequent Revisions must be marked as "X#" (where # relates to the number of resubmissions) and dated; and
    - Final Revision must contain the notation "Approved Works as Executed" and dated;
- All changes from the approved design are marked-up in red including:
    - Any additional items constructed;
    - Any items not constructed (denoted by a strikethrough line and an "X" or cross); and
    - Confirmation of any changes to existing infrastructure.
- Detention basin capacity is to be confirmed by survey at maximum 200mm depth increments provided in the form of a volume/elevation table to ensure it conforms to the designed capacity;
- Any works bonded under Sections 1.7.3 should be subject to the submission of additional Works-As-Executed documentation in accordance with Section 1.8 and that any release of the bonds is contingent on this documentation being submitted to and approved by the City; and
- Any works that are proposed to be bonded and installed later should be clearly marked as such.

1.8.2 Electronic submission requirements

Adobe PDF

- All sheets in an approved set of plans (the "Complete Plan Set") must be submitted in a single file, in page order;
- Each plan must be full-scale (A1 or A3);
- Each plan must be an electronic rendition; and
- Each plan must be legible, particularly if a scanned document. City staff will determine whether acceptability of legible plans on a case-by-case basis.

AutoCAD files

- Must be submitted with each set of the PDF files for City review;
- Drawings must be an acceptable DWG file version
    - The City can accept up to and including the latest DWG or 12D file version;

- Drawings must be on MGA (Zone 56) co-ordinates, with AHD datum;
- Drawings must only contain:
    - Final lot layout;
    - New and altered infrastructure locations;
    - Location of any existing infrastructure where newly installed infrastructure interfaces;
    - Labelling (if appropriate); and
    - Layering by asset type (water, sewer, stormwater, roads).
- Each asset must be represented by a single feature (nodes/pits can be a block, pipes must be single line. Line types can be used where appropriate); and
- Where pipes connect they must share a common vertex (and where appropriate share that vertex with a node/pit).

Hydraulic model

- A hydraulic model using the Works as Executed survey data shall be submitted as part of the WAE documentation if the constructed stormwater differs significantly from the design to demonstrate the constructed stormwater network satisfies the design criteria. The City shall determine if the changes are significant enough to warrant an update of the model based on the submitted WAE plans of the constructed stormwater pipe size and grade. Where required, the revised hydraulic model should capture as a minimum:
    - Actual basins depth/capacity;
    - Changes in pit locations; and
    - Changes in pipe grades of greater than 10% of the design grade. For small changes in pipe grades and pit invert/surface levels, the design levels may be used.

1.8.3 Quality assurance package

The full quality assurance package must be submitted to the City for review including all testing results, completed Inspection test plans and conformance surveys.

Pavement conformance survey

Results of the pavement conformance survey must be submitted as follows:

- Results must be produced in a tabular form;
- For each constructed road, at each cross section indicated on the design plans at the following locations:
    - Centreline; and
    - Each side of the road at the lip line or road shoulder.
- Subgrade level;
- Finished surface level (as indicated on the WAE plans); and
- Conformance figure being the difference between the pavement design depth and the as-constructed depth (finished surface level minus subgrade level).

Allotment fill conformance

- All allotment fill testing results are to be provided to the City as part of the quality documentation submitted with the Work as Executed plans; and
- Finished levels and depth of fill is to be confirmed on the Work as Executed plans.

1.8.4 Submission requirements

All Works as Executed submissions must be in accordance with Part 1 - Table A - plan submission requirements.

1.8.5 Survey / plan of easements

A Registered Surveyor is to supply a plan demonstrating that all infrastructure installed are wholly located within their respective easement, reserve or street allocations as per the approved engineering plans and in accordance with the tenure/easement requirements set out in this document.

The plan must:

- Show the finalised lot layout;
- Show the location of all constructed infrastructure;
- Show the location of all easements, reserves and/or street allocations (existing or proposed) containing infrastructure; and
- Demonstrate compliance with the City's tenure/easement requirements, including but not limited to tenure type, width.

I _____ certify that this plan is a true and accurate record of the works approved by the certifying authority _____ as actually constructed and that all constructed works are located within proposed easement, reserve or street allocations in accordance with the requirements as set out in the City's Technical Guideline for Infrastructure Design.

NAME: _____

SIGNATURE: _____

CAPACITY: _____

REGISTRATION NO: _____

DATE: _____

1.9 Penalties

Penalties will apply for Developers/Consultants in the following instances:

- In the case of consents granted under the Local Government Act, Roads Act or Environment Planning Act, plans that are submitted to the City which contain misleading information or false certification in respect compliance with the requirements of this Technical Guideline;
- Works as Executed drawings are submitted to the City which, at any time after submission are found to not accurately reflect the actual work completed; and
- They City reserves the right to issue a re-assessment fee if deemed the plans submitted to the City fail to contain the minimum information indicated in this Technical Guideline.

1.10 Miscellaneous

1.10.1 Supervision

The City will hold responsible the applicant to whom the development approval is issued, to complete or to cause the completion of all development works in accordance with the terms of the development approval and the approved plans and specifications.

“Approved” means that the plans and specifications meet the City’s requirement. This does not absolve the developer of the responsibility of rectifying any errors or omissions in the plans and specifications which may become evident during construction.

Where the development involves construction of civil engineering works, the developer shall appoint a superintendent approved by the City’s representative who shall be responsible for the execution of the works. No work shall commence until the developer has advised the City in writing the name of the appointed superintendent.

The City reserves the right to withdraw its approval at any time of the developers nominated representative. Where the City’s representative suspects on reasonable grounds that the required level of supervision and inspection is not being undertaken, the City will:

- notify their developers representative in writing of the suspected noncompliance as soon as reasonably practical after identification of any non-compliance; and
- refrained from accepting the works on maintenance until the issue is satisfactorily resolved.

The superintendent must properly supervise the works and inspect them with sufficient frequency to ensure that the materials and workmanship conform to the requirements of the approved plans and specifications.

The superintended must be present at all inspections which require the City’s representative to be present.

The City reserves the right to fail any inspection and require payment of a re inspection fee if its representative concludes that any work is unsatisfactory, or any correspondence submitted by the superintendent indicating that the site is ready for an inspection is found to be incorrect. The reinspection fee is calculated in accordance with the City’s fees and charges schedule. The fee must be paid prior to reinspection.

The superintendent must ensure the prompt action is taken to eliminate hazards or problems experienced by other parties where those hazards or problems result from the development construction activities (for example, dust issues, smoke, machinery noise outside approved working hours, re direction of storm water and silt washing onto adjacent properties). This action is to be taken at the developers cost even if the superintendent is directed either verbally or in written off such problems by the City’s representative. The required remedial works may involve undertaking temporary engineering works acceptable to the City. (Any verbal direction given by the City’s representative will be confirmed in writing as soon as reasonably practical after initial direction is given).

Where immediate action is not taken to eliminate identified hazards or problems, the City may undertake any necessary permanent or temporary remedial works at the developers risk and expense and may recover the costs of those remedial works from the developer as a debt payable on demand. Until payment is made those costs will constitute a charge upon the land.

The Superintendent must nominate haul routes to be used during construction. These routes must be approved by the City. During construction, any damage to road pavements, services or street furniture

along the route identified as being caused by the contractor must be repaired to the satisfaction of the City. Where safety is compromised the City may expect the work to be made safe immediately or carry out any necessary work at the contractor's expense.

1.10.2 Insurance

Contractors/consultants engaged in the preparation of plans and the administration of construction works associated with approved developments, on City owned property or road reserves must hold current certificates of currency of insurances including, workers compensation, motor vehicle 3rd party property damage, public liability and professional indemnity for civil engineering design.

The value of insurance shall be determined by the developer however shall be a minimum value as specified below:

- Workers compensation: as per the current law;
- Motor vehicle 3rd party property damage: $20 Million;
- Public Liability: $20 Million; and
- Professional Indemnity: $500,000 or 20% of the cost of the construction works, whichever is the greater, to a maximum of $5 million.

The City will annually check that the necessary insurance remains current.

1.10.3 Allotment filling

The importation of fill or soil to the site must be in accordance with the provisions of the Protection of the Environment Operations Act 1997 and the Office of Environment and Heritage 'Waste Classification Guidelines' and shall comply with the terms of any approval issued by the City.

Any proposed allotment filling on residential or commercial subdivisions or developments shall be shown on the drawings, including the location, quantity required and source material. Design surface levels are to be shown on construction plans.

Topsoil (as defined in AS 3798) required to be removed during the works and re-instated following completion is not required to be included in lot filling declarations, provided this fill is less than 150mm thick.

All allotment filling shall be designed, constructed and tested in accordance with Australian Standard AS 3798 – Guidelines for Earthworks for Residential and Commercial Developments.

1.11 ANNEXURE A – Certification

I ..... [*Print Name*] of ..... [Print *address*] hereby certify as follows:

1. I am a person qualified in accordance with Clause 1.5.3 of the Coffs Harbour Technical Guideline for Infrastructure Design

2. I am aware and accept that the City of Coffs Harbour is relying upon my professional skill and experience in designing/supervising the construction of the following works;

    a.

    b.

3. I am aware that the reviews undertaken by the City of submitted designs and inspections of the works are limited to regulatory purposes only and the City relies upon my qualifications, skill and experience and my certification for the purpose of confirming that the works have been designed and completed in a competent manner in accordance with the Coffs Harbour Technical Guideline for Infrastructure Design together with all relevant standards and investigations which would be expected to be applied or undertaken by an engineer.

4. I hereby expressly authorise the City to rely upon this certification to be satisfied of the standard of design and confirm that no further verification or enquiry should be made by the City in relation to verifying the quality of construction in relation to those works.

5. I confirm my understanding and accept that the purpose of this certification is firstly to confirm that the works have been designed in a prudent and professional manner and secondly to confirm for the purposes of professional liability that I understand that the City is relying upon my professional skill, experience and diligence to be satisfied that the works have been designed to the standards required by the Coffs Harbour Technical Guideline for Infrastructure Design together with all other relevant standards and investigations which would be expected to be applied or undertaken by an engineer and as such I confirm that I have an enforceable duty to the City to ensure the work has been completed in the manner relied upon by the City.

Name: _____

Signature: _____

Position: _____

Date: _____

1.12 ANNEXURE B – Departure application documents

Design departure application form

Description of development	Click here to enter text.			
Location of Work	**Street Address**	Click here to enter text.	**Lot/DP**	Click here to enter text.
The City Reference No	Click here to enter text.			
Departure Subject	Click here to enter text.			
Affected Drawings	Click here to enter text.			
Raised By	Click here to enter text.			
Date Raised				

Departure Request

Click here to enter text.

Designer Commentary

Click here to enter text.

Extent of Impact

Click here to enter text.

Policy Implications

Click here to enter text.

Financial Implications

Click here to enter text.

Other Implications *e.g. Easements, Property Acquisitions*

Click here to enter text.

Community Consultation

Click here to enter text.

Title	Name	Signature	Date
Applicant	Click here to enter text.		

Checklist for Application for Design Departure

Description of development	Click here to enter text.			
Location of Work	**Street Address**	Click here to enter text.	**Lot/DP**	Click here to enter text.
The City Reference No	Click here to enter text.			
Departure Subject	Click here to enter text.			
Affected Drawings	Click here to enter text.			

Application Checklist	Completed
Application form completed and signed in PDF Format	☐
Checklist completed and attached	☐
Supporting documentation for assessment of the proposal including assessment of alternative options completed and attached	☐
Evidence showing cross discipline checks have been conducted for impacts on other design components including electrical, telecommunications, gas, water, sewer, drainage, planning, and transport	☐
Any other items deemed necessary to support the application	☐
Letter of outcome in word format pre-populated	☐

Please note that the application will not be assessed unless all appropriate documentation has been provided.

Submission Representative Certification			
Title	**Name**	**Signature**	**Date**
Applicant	Click here to enter text.		

Design departure report of outcome

Description of development	Click here to enter text.			
Location of Work	**Street Address**	Click here to enter text.	**Lot/DP**	Click here to enter text.
The City Reference No	Click here to enter text.			
Departure Subject	Click here to enter text.			
Affected Drawings	Click here to enter text.			
Raised By	Click here to enter text.			
Date Raised				

City Response

Click here to enter text.

Departure Application Result	**Approved** ☐	**Rejected** ☐

Title	Name	Signature	Date
Group Lead	Click here to enter text.		
Applicant	Click here to enter text.		

PART 2

TECHNICAL GUIDELINE

FOR

ROADS

2 Technical guideline for roads

2.1 Introduction and objectives

This section of the Technical Guideline outlines the minimum requirements for the design of roads and paths in the Coffs Harbour Local Government Area.

The primary design objective is to facilitate the expansion of the City road network whilst ensuring the following:

- Provision of a safe environment for all users of the road reserve;
- Development of a network that balances the existing and anticipated future demands of the City; and
- Design of pavements that meet minimum serviceability standards for design life to minimise the need for maintenance.

The design of roads shall be based on best practise engineering standards and shall meet or exceed the requirements of these Guidelines as well as relevant sections of Standards and publications referenced herein.

The design of roads should be undertaken with consideration of the design of other services including those nominated in the sections listed below:

Part 1	General Requirements
Part 3	Technical Guideline for Design of Stormwater Drainage and WSUD
Part 4	Technical Guideline for Design of Water Reticulation
Part 5	Technical Guideline for Design of Sewerage Reticulation
Part 6	Technical Guideline for Landscaping
Part 7	Technical Guideline for Bulk Earthworks and Retaining Walls

References

Part 2 of the Technical Guideline should be read and utilised in combination with the following publications as referenced throughout:

- Austroads - Road Design Guide, Parts 1-7
- Austroads – Design Vehicles & Turning Path Template Guide
- Austroads - Guide to Pavement Technology, Parts 1-9
- AAPA National Asphalt Specification
- AS 1100 – Technical Drawing
- AS 1141 – Methods of Testing Aggregates
- AS 1158 – Australian Standard for Public Lighting
- AS 1289 – Method of Testing Soils for Engineering Purposes
- AS 1379 – Specification and Manufacture of Concrete
- AS 1428 – Design for Access and Mobility

- AS 1742 – Manual for Traffic Control Devices
- AS 2008 – Residual Bitumen For Road Pavements
- AS 2150 – Hot-Mix Asphalt – A Guide to Good Practice
- AS 2758 – Aggregates and Rocks for Engineering Purposes
- AS 2890 – Parking Facilities
- AS 3845 – Road Safety Barrier Systems.
- NSW Streets Opening Conference – Guide to Codes and Practises for Streets Opening
- City of Coffs Harbour Construction Specifications
- City of Coffs Harbour suite of Standard Drawings

2.2 Definitions

All references to the Group lead should be interpreted as referring to the Group lead of the respective asset or their nominated representative.

All testing to Australian Standards is to be conducted by a NATA accredited testing authority.

A built-up area is considered to be roadside development comprising property accesses at spacings averaging less than 100m over distances of at least 500m[1].

A rural area is considered to be a roadside development with an average lot size greater than 4,000m^2.

An Engineer is a person with a qualification from an accredited program listed as acceptable for Membership of The Institution of Engineers Australia, a person who has been assessed as meeting the Stage 1 Competency Standard as assessed by Engineers Australia or a person with equivalent qualifications and experience and is deemed to be suitably experienced by the City. All weather Access – an access which can be safely traversed by a 2 wheel drive vehicle and or associated design vehicle in inclement weather. The access may need to be sealed to comply with requirements of the Rural Fire Service (RFS) Planning for Bushfire Protection Guideline. Accesses steeper than 15% grade must be sealed with asphaltic concrete, bitumen seal or concrete.

2.3 Road application documents

The following information shall be submitted in support of an application for a relevant certificate or consent that is being applied for including a Construction Certificate, Civil Works Certificate or Subdivision Works Certificate and is considered the minimum list of requirements.

2.3.1 Design drawings

Design drawings shall be submitted to the City for approval. Information to be included in the design drawings is detailed in Part 2.14 APPENDIX A – Information to be shown on drawings.

2.3.2 Design checklists

Each of the supporting items or documents listed in the checklists in Part 2.15 APPENDIX B – Checklists shall be completed and submitted with the drawings. Should any of the items required in any checklist be outstanding or not to a standard acceptable to the City, the drawings and checklists shall be returned to the *Developer's Representative* for amendment. The City shall only commence

[1] *Taken from definitions in AS1742.3*

review of the design drawings once it is satisfied that all the requirements of the checklists have been met.

2.4 Road types, classifications and design elements

2.4.1 General

Roads are generally composed of combinations of some or all of the following key elements:

- Travel lanes;
- Parking lanes;
- Footway reserves;
- Stormwater drainage infrastructure;
- Structural or reinforced pavement;
- Wearing surface;
- Linemarking and Signage;
- Safety barrier;
- Street trees;
- Street lighting;
- Electricity distribution; and
- Provision of services.

The inclusion or exclusion of any or all of these elements as well as the specific requirements for each particular road within a subdivision or development shall be determined by the City and will be based on the size, type, location and nature of the subdivision or development, the requirements of local planning instruments such as the Local Environment Plan (LEP), Development Control Plans (DCP), Development Servicing Plans (DSP), Pedestrian Access Management Plans (PAMP) and any other policies, specifications and guidelines as required. The Developer shall also consider the requirements of the Rural Fire Service (RFS) Planning for Bushfire Protection Guideline, which may require increased requirements than what is specified in this guideline.

For the majority of roads being designed within the City LGA, the combination of design elements will fall within one of the Road Design Standard (RDS) categories as per Table 2-A. The City will assign an RDS to each road within a subdivision or development as a condition of development consent.

Where a standard RDS as per Table 2-A is not appropriate for roads within a particular subdivision or development, the City will determine the requirements for each design element for the roads as a condition of development consent.

Table 2-A - Road design standard (RDS) matrix

Design Element	RDS 1	RDS 2	RDS 3	RDS 4	RDS 5
Kerb and gutter	✓	✓	×	×	×
Formed footway	✓	✓	×	×	×
Piped underground stormwater drainage	✓	✓	×	×	×
Surface drainage	×	×	✓	✓	✓
Asphalt wearing surface	✓	×	×	×	×
Sprayed bitumen wearing surface	×	✓	✓	✓	×
Unsealed gravel wearing surface	×	×	×	×	✓[1]
Street lighting	✓	✓	✓	×	×
Above ground electricity distribution	×	×	×	✓	✓
Below ground electricity distribution	✓	✓	✓	×	×

[1] Full width sprayed bitumen wearing surface is required for a minimum of 50m on approaches to intersections with sealed roads and 30m on approaches to sealed causeways.

2.4.2 Road classifications and formation widths

Roads are typically categorised according to the function of the road within the entire road network, as well as the nature and volume of traffic expected to utilise the road once all stages of the development have been completed and is related to the number of lots serviced by each road. A description of the different road classifications are provided in Table 2-B and typical pavement, verge and road reserve widths for each classification of road are contained in the road hierarchy table provided in Table 2-C.

Table 2-B - Road classifications

Classification	Movement function	Access function	Description
Arterial	Major	Minimal	The highest order roads with the primary function of carrying traffic between towns and cities. Arterial roads shall be developed, or have the capacity to be developed into multi-lane facilities with access control being a desirable feature to enhance traffic flow.
Sub-Arterial	Significant	Minor	Road with the main function of connecting the collector road network to the arterial roads. Sub-arterial road supplement arterial roads in providing for traffic movements between the industrial, commercial and residential areas of a town or city.
Collector	Minor	Significant	Collector roads provide access into and out of a neighbourhood to the wider road network from local roads. These roads may provide access to individual industrial facilities and links to local shopping centres. Collector roads are expected to carry a minimum traffic catchment of approximately 200 lots or more, and are not used for longer distance travel,

			except at the beginning or end of the journey. Collector roads help to distribute traffic at the neighbourhood level and may provide access to abutting properties. Ideally they should discourage through traffic by not providing continuous through routes between higher order roads.
Local	Minimal	Major	The main function of a local road is to provide access to properties with no direct through movement between neighbourhoods. A local road may have one or more entry/exit point and services a minimum of 15 potential dwellings.
Access	None	Major	The lowest order road. An access road has only one entry/exit point (such as a cul-de-sac) servicing a maximum of 15 potential dwellings (not based on lots).
Laneways	None	Major	Laneways are narrow streets that are predominantly provided between local or collector roads and have the overarching purpose of providing rear access to properties. Laneways shouldn't be used in lieu of a local or access road when it provides the primary access to a lot(s).

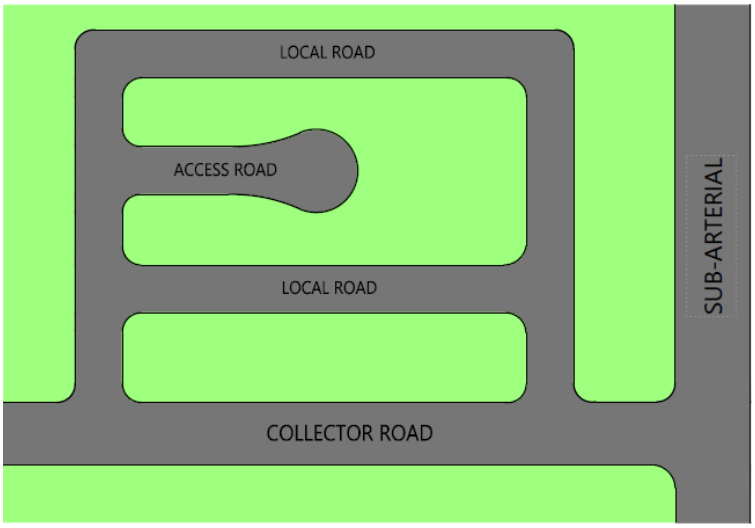

Figure 1 – Road Classifications

A **dwelling** as defined in the Coffs Harbour LEP 2013 means a room or suite of rooms occupied or used or so constructed or adapted as to be capable of being occupied or used as a separate domicile.

Generally, arterial and sub-arterial roads form the basis for the major road system, whilst the collectors and the local roads form the basis for the internal road system within the subdivision or development. Local and access roads shall not interact directly with an arterial or sub-arterial road where an alternative is available.

The road and street network shall also be consistent with the principles setout in the NSW government *Network Planning and Precincts Guide*.

Subdivision and development proposals are to show the proposed hierarchy on the design drawings as well as in the Traffic Impact Study. When preparing the proposed road hierarchy plan for the

subdivision or development, consideration shall be given to the function of the road within the entire network, the expected traffic volume and the connection with the adjacent road network.

The road classification to be adopted and the formation widths to be used for design purposes will be approved by the City following a detailed analysis of the proposed site, the design traffic and the nature and function of the subdivision or development. The adopted road classification and width shall apply to the entire length of the road. Progressive changes to the road classification will not be permitted.

When calculating the proposed classification or function of a road, the Developer's Representative must consider the ultimate number of lots serviced by the road when all potential stages of development and subdivision are complete. Consultation with the City regarding the ultimate function of the road may be necessary.

It is the Developer's Representative's responsibility to ensure that road reserve widths are sufficient to accommodate all road and ancillary services and utilities that are required to be located within the reserve and the road reserve may need to be wider than the minimum width detailed in Table 2-C. Consultation with relevant service authorities such as telecommunications and electricity distribution authorities to determine their requirements for the subdivision may be necessary.

Widths in Table 2-C may need to be varied to maintain continuity of services e.g. parking lanes and bike lanes. Road width shall also accommodate lane widening on curves and turn treatments/lanes where the expected traffic generation of a development determined from first principles based on the land zoning would warrant them.

Table 2-C - Road classifications, formation widths and design traffic

Road Classification[5]	Indicative Design Traffic	RU2 Rural Landscape RDS5	R1 General Residential RDS1 / RDS2	R2, R3, R4 Low, Medium and High Density Residential RDS1 / RDS2	R5 Large Lot Residential RDS3 / RDS4	E1 to E5 Business, Industrial RDS1	SP1 Special Activities RDS1
Arterial	As determined per pavement design.	30m Road Reserve	34m Road Reserve	34m Road Reserve	30m Road Reserve	34m Road Reserve	34m Road Reserve
		2 x Travel Lanes, 3.5m wide	4 x Travel Lanes[2], 3.5m wide	4 x Travel Lanes[2], 3.5m wide	2 x Travel Lanes[2], 3.5m wide	4 x Travel Lanes[2], 3.5m wide	4 x Travel Lanes[2], 3.5m wide
		2 x Shoulder, 2.5m wide[1]	2 x Parking Lanes, 3.0m wide[1,]	2 x Parking Lanes, 3.0m wide[1,]	2 x Shoulder, 1.5m wide[1,]	2 x Parking Lanes, 3.0m wide[1,]	2 x Parking Lanes, 3.0m wide[1,]
Sub-Arterial	As determined per pavement design.	30m Road Reserve	32m Road Reserve	32m Road Reserve	30m Road Reserve	30m Road Reserve	32m Road Reserve
		2 x Travel Lanes, 3.5m wide	2 x Travel Lanes[2], 3.5m wide	2 x Travel Lanes[2], 3.5m wide	2 x Travel Lanes[2], 3.5m wide	2 x Travel Lanes[2]; 3.5m wide	2 x Travel Lanes[2], 3.5m wide
		2 x Shoulder, 2.0m wide[1]	2 x Parking Lanes, 3.0m wide[1]	2 x Parking Lanes, 3.0m wide[1]	2 x Shoulder, 1.0m wide[1]	2 x Parking Lanes; 3.0m wide[1]	2 x Parking Lanes, 3.0m wide[1]
Collector	Min 2 x 10^6 ESA Min AADT = 2000 with 7% HV and 40 yr life. See note 3	25m Road Reserve	21.6m Road Reserve	22.6m Road Reserve	25m Road Reserve	23m/28m Road Reserve[4]	22.6m Road Reserve
		2 x Travel Lanes, 3.5m wide	2 x Travel Lanes; 3.5m wide	2 x Travel Lanes; 3.5m wide	2 x Travel Lanes; 3.5m wide	2 x Travel Lanes; 3.5m wide	2 x Travel Lanes; 3.5m wide
		2 x Shoulder, 1.0m wide[1]	2 x Parking Lanes, 2.3m wide[1]	2 x Parking Lanes, 2.8m wide[1]	2 x Shoulder, 1.0m wide[1]	2 x Parking Lanes; 3.0m or 5.5m wide[1]	2 x Parking Lanes, 2.8m wide[1]
Local (high volume)	Min 3.3 x 10^5 ESA Min AADT = 1200 with 6% HV and 40 yr life. See note 3	20m Road Reserve	20.6m Road Reserve	20.6m Road Reserve	20m Road Reserve	23m Road Reserve	20.6m Road Reserve
		2 x Travel Lanes, 3.0m wide	2 x Travel Lanes; 3.0m wide	2 x Travel Lanes; 3.0m wide	2 x Travel Lanes; 3.0m wide	2 x Travel Lanes; 3.5m wide	2 x Travel Lanes; 3.0m wide
		2 x Shoulder, 1.0m wide[1]	2 x Parking Lanes, 2.3m wide[1]	2 x Parking Lanes, 2.3m wide[1]	2 x Shoulder, 1.0m wide[1]	2 x Parking Lanes; 3.0m wide[1]	2 x Parking Lanes, 2.3m wide[1]

Road Classification[5]	Indicative Design Traffic	RU2 Rural Landscape RDS5	R1 General Residential RDS1 / RDS2	R2, R3, R4 Low, Medium and High Density Residential RDS1 / RDS2	R5 Large Lot Residential RDS3 / RDS4	E1 to E5 Business, Industrial RDS1	SP1 Special Activities RDS1
Local (low volume)	Min 1.5×10^5 ESA Min AADT = 500 with 6% HV and 40 yr life. See note 3	20m Road Reserve 2 x Travel Lanes, 3.0m wide 2 x Shoulder, 1.0m wide[1]	18.6m Road Reserve 1 x Travel Lanes; 4.0m wide 2 x Parking Lanes, 2.3m wide[1]	18.6m Road Reserve 1 x Travel Lanes; 4.0m wide 2 x Parking Lanes, 2.3m wide[1]	20m Road Reserve 2 x Travel Lanes; 3.0m wide 2 x Shoulder, 1.0m wide[1]	23m Road Reserve 2 x Travel Lanes; 3.5m wide 2 x Parking Lanes; 3.0m wide[1]	20.6m Road Reserve 2 x Travel Lanes; 3.0m wide 2 x Parking Lanes, 2.3m wide[1]
Access	Min 8×10^3 ESA Min AADT = 90 with 3% HV and 40 yr life. See note 3	20m Road Reserve 2 x Travel Lanes, 3.0m wide 2 x Shoulder, 0.5m wide[1]	18m Road Reserve 1 x Travel Lanes; 3.0m wide 2 x Parking Lane, 2.5m wide[1]	18m Road Reserve 1 x Travel Lanes; 3.0m wide 2 x Parking Lane, 2.5m wide[1]	20m Road Reserve 2 x Travel Lanes; 3.0m wide 2 x Shoulder; 0.5m wide[1]		
Laneway	Site specific; to be determined based on first principles		6m road reserve width with 5m road pavement	6m road reserve width with 5m road pavement		6m road reserve width with 5m road pavement	
Formed driveway	Min 2.3×10^3 ESA (for each allotment)	See Coffs Harbour Development Control Plan	See Coffs Harbour Development Control Plan	See Coffs Harbour Development Control Plan	See Coffs Harbour Development Control Plan		

[1] Shoulders and parking lanes are to be constructed with the same pavement as travel lanes.

[2] The road pavement may require additional width to accommodate dedicated turn lanes into traffic attracting destinations, as required by the project specific traffic impact assessment report.

[3] The indicated ESA values are a minimum for the associated road classification. The Indicative design traffic is based on those specified in Austroads Guide to Pavement Design for the road classification and is for residential areas only. The traffic loading presented in the table is not suitable for commercial or industrial areas and should be determined from first principles using Austroads Guide the Pavement Technology Part 12 in those instances. The design traffic to be adopted in the traffic impact assessment and the pavement design should be consistent with traffic counts on similar roads within the neighbourhood or development as appropriate and the indicative values provided in this table should only be used as a last resort and in the absence of any other information.

[4]The width of the road reserve is dependent on whether angled parking or parallel parking is adopted. The type of parking to adopt shall be agreed with the City and should be based on the intended land use, the likely demand for on street parking and other desired outcomes for the street.

[5] The classification of a road type shall be determined based on the number of lots within the catchment that is expected to use that particular road. See Table 2-B for the assumed number of lots for each road classification.

2.5 Design parameters for roads and pathways

2.5.1 General

The design of roads shall include the following as a minimum:

- Consideration of the function of the road and its context including the nature and volume of traffic, all users of the road reserve, the adjoining land uses and the place function;
- Geometric design, including analysis of existing and proposed levels, gradients and alignments;
- Formation and carriageway cross section and kerb return design;
- Intersection analysis and design;
- Earthworks requirements;
- Pavement design;
- The provision of existing and proposed services, structures and ancillary facilities;
- The provision of vehicle access to each lot;
- The provision of safe pedestrian and cyclist movement and an integrated network of footpaths and bicycle paths, the latter may include mixing with traffic on local streets;
- Construction management; and
- Any other relevant details.

Sections 2.10 and 2.11 of this document relate to intersection design and pavement design respectively.

2.5.2 Road reserves

2.5.2.1 *Road reserve width*

The minimum width of road reserves shall be in accordance with Table 2-C.

Road reserve widths must be sufficient to accommodate the road formation including batters, required services and utilities with approved clearances, pedestrian and bicycle access where required, parking, stormwater drainage and bus routes where development is significant.

Should the development design incorporate water sensitive urban design principles the road reserve may need to be wider than that specified in Table 2-C.

2.5.2.2 *Road reserve boundaries*

Road reserve boundaries may be curved, but where they are to be fenced as chords, the chord lengths should not be less than 10 metres. Where several such chords occur adjacent to each other they shall, wherever practical, be equal in length.

2.5.2.3 *Carriageway width*

The nominal carriageway widths are shown in Table 2-C.

2.5.2.4 *Footway (verge) width*

The footway reserve is that part of a public road exclusive of the carriageway and is to be of width prescribed in Table 2-C for each road classification.

The footway width in built-up areas is minimum 5.0m to ensure that all required services and utilities can be adequately situated for the required width within their verge allocation.

The width of the footway in rural areas is dependent on the nature and size of storm water drainage infrastructure, and the allocation for street trees (if required). The footway must have adequate width so that drainage infrastructure such as table drains are located wholly within the verge and do not spill onto adjoining properties. The designer shall consider the topography of the upstream and downstream catchments when determining if table drains are required on both sides of the road formation.

Notwithstanding the requirements of Table 2-C , the City requires the provision of footpaths in accordance with Table 2-D. The City may also require the inclusion of paved footpaths, cycle paths or shared paths at any location within a subdivision if specified within the City's Movement and Place Strategy or as warranted by existing or predicted pedestrian and/or bicycle movements.

Notwithstanding the requirements of Table 2-C, the footway reserve of any commercial subdivision or development (E1 to E5 zoning) where businesses front the verge shall be concrete from the kerb to the property boundary unless otherwise agreed with the City.

Concrete footpaths and shared paths shall be designed as per the City's Standard Drawing 200 series. Kerb ramps as per Australian Standard 1428.1 shall be provided at all kerb and gutter crossings where concrete footpaths are constructed.

The service and utility allocation corridors in footways for built-up and rural areas are detailed in Section 2.9.6.1 of this document and are shown in the City's Standard Drawing 200 series.

2.5.2.5 *Footway crossfalls*

In commercial areas where the footway reserve is to be totally paved with concrete or interlocking pavers from the kerb to the adjacent property boundary, the cross-fall is to be nominally 2% towards the carriageway edge. For areas such as concrete footpaths and paved areas, the crossfall is to be nominally 2.5%.

In areas where the footway reserve is unpaved or partially paved, cross-fall from kerb to the adjacent property boundary is to be nominally between 2% and 6% towards the carriageway edge.

2.5.2.6 *Pathways, bicycle paths and shared paths*

A Pathway is defined as a public road of width three metres or less, generally designed for the use of pedestrians and/or cyclists as an access from or between roads.

Pathways dedicated to the public or as access to public garden and recreation space shall be cleared and formed, with a concrete path as per Section 2.5.2.4.

The nominal width for a pathway varies with respect to its anticipated service level. Table 2-D provides the minimum pathway widths to be utilised in the design. The determination of the predicted demand shall be based on the location of the path and its intended use. Examples for applications for each of the pathway widths are provided to assist in the determination of the path demand.

Table 2-D – Pathway widths and functionality

Path Type	Predicted demand	Minimum width (mm)	Application of pathway
Footpaths	Low demand	1500	• Low density residential areas • Passing of wheelchairs and wider wheeled-devices can occur at driveways
	Medium demand	1800	• Medium to high density residential areas • On key walking routes to small to medium sized schools • At small to medium shopping areas • Passing of wheelchairs and wider wheeled-devices can occur on footpath
	High demand	2400	• Medium to large commercial shopping areas • On key walking routes to large schools • Outside key sporting facilities • Passing of wider wheeled-devices can occur on footpath
Shared path[1]	Low demand	2500	• Local access path
	Medium demand	3000	• Regional path • Path with medium to high demand of either pedestrians or cyclists
	High demand	3500	• Recreational path • Path with high demand
Bicycle Path[1]		2500	• Local access path
		3000	• Regional path

[1] As agreed with the City for the intended use and with consideration of alignment with the City's strategic active transport network

High demand pathway widths shall be applied in areas where anticipated pedestrian traffic is high and the pathway is expected to cater for multiple user groups such as developments within the CBD and commercial areas.

All dedicated bicycle paths and shared paths shall have a minimum width based on the intended use of the path and the expected pedestrian and cyclist volumes. The width of such paths shall be site

specific and shall agreed with the City's representative. Bicycle and shared paths shall be designed in accordance with Austroads Guide to Road Design 6A and the City's Standard Drawing 200 series.

Table 2-E provides the City's desirable and minimum location of pathways on new and existing roads. The minimum location is the baseline for developers and designers to provide a pathway. The desirable locations provide the safest and best outcome for pedestrians and the City would encourage developers and designers to consider the desirable locations where appropriate. Pathways are not required in Industrial zoned areas.

Table 2-E – Recommended provision of footpaths for road reserves in different land uses

<table>
<tr><th rowspan="3">Land use</th><th colspan="4">Pedestrian path provision</th></tr>
<tr><th colspan="2">New roads</th><th colspan="2">Existing roads</th></tr>
<tr><th>Desirable</th><th>Minimum</th><th>Desirable</th><th>Minimum</th></tr>
<tr><td>Commercial</td><td colspan="2" rowspan="3">Both sides</td><td colspan="2" rowspan="3">Both sides</td></tr>
<tr><td>Residential (arterial / sub-arterial roads)</td></tr>
<tr><td>Residential (collector roads)</td></tr>
<tr><td>Residential (local streets)</td><td rowspan="3">Both sides</td><td rowspan="3">One side</td><td rowspan="2">Both sides</td><td rowspan="2">One side</td></tr>
<tr><td>Residential (access streets)</td></tr>
<tr><td>Large lot residential (3 to 10 dwellings per hectare)</td><td rowspan="2">One side</td><td rowspan="2">Shoulders on both sides</td></tr>
<tr><td>Large lot residential (fewer than 3 dwellings per hectare)</td><td>One side</td><td>Shoulders on both sides</td></tr>
</table>

The thickness of a pathway varies depending on the loading it is subject to. Table 2-F provides the pathway type and corresponding loading and thickness which are generally based on the requirements of AS 3727. Light Duty loading is typical for locations where vehicles are unlikely to drive on the path. Intermediate duty loading is typical for locations where light vehicles may cross the path, such as residential driveways. Heavy duty loading is typical for locations where commercial vehicles may cross the path, such as locations with loading bays etcetera.

Table 2-F – Pathway type and loading

Pathway Type	Description of loading	Thickness (mm)
Type 1 – Light Duty Loading	Pedestrians only	100
Type 2 – Intermediate Duty Loading	Pedestrians and light vehicles up to 3 Tonnes	125
Type 3 – Heavy Duty Loading	Pedestrians and commercial vehicles up to 10 Tonnes	150

Any pathway with a low or medium demand level of service which deviates from an alignment that is greater than 30 degrees will require a splay which shall be designed in accordance with Australian

Standard AS1428.1 – Design for access and Mobility. Curved alignments for medium demand level of service pathways shall be adopted in lieu of angular splays where possible to improve functionality and aesthetics.

Intersecting footpaths and shared paths that may be used by cyclists (eg near primary schools) shall incorporate a minimum curve radius of 2.5m.

Generally the maximum permissible longitudinal grade for pathways shall be 15%. Where grades are excessive, pathways shall be designed in accordance with Australian Standard AS 1428 Design for Access and Mobility and design considerations such as short flatter sections of path or additional path width may be required to provide some relief from the grade or to allow for passing pedestrians. The maximum permissible longitudinal grade to be used in pathways providing access to public gardens and reserves shall be 8%.

Path crossfalls shall be determined based on the intended use of the path and the path material, as per Table 2-G. The maximum crossfall of paths in existing road reserves may be increased to a maximum of 5% at existing driveways if the crossfalls specified in Table 2-G can not be achieved without driveway remediation works extending into the private property.

Table 2-G - Path Cross fall

Path Material	Intended Use	Desired crossfall	Min / max crossfall[1]
Concrete	Disabled Compliant	2.0%	2.0% to 2.5%
	Not disabled compliant	2.5%	2.0% to 3.0%
Asphalt	Disabled Compliant	2.0%	2.0% to 3.3%
	Not disabled compliant	2.5%	2.0% to 3.5%

[1] for infill development where the maximum path crossfall creates significant reconstruction of existing driveways, a desirable maximum crossfall of 8% and absolute maximum crossfall of 12% will be considered by the City.

The hydraulic capacity of formed pathways must be considered where pathways are to be utilised as overland flow paths.

2.5.3 Design traffic

The Design Traffic for use in road geometry and pavement thickness calculations shall be determined by analysis of existing traffic movements, through traffic, and an estimate of traffic generated by existing and future development.

For road geometry, road classification and intersection design, the principles outlined in the Austroads Guide to Traffic Management Parts 1-12 shall be used to estimate the quantity, nature, and distribution of traffic generated by the development.

Additionally, for pavement thickness design calculations, the principles outlined in Section 7 of Austroads Guide to Pavement Technology, Part 2 shall be used to calculate the traffic loading on the pavement. The growth rate to be applied to the design traffic shall be determined in consultation with the City's representative.

In all cases the design traffic shall be that predicted at the end of the pavement design life as per Section 2.11.2 of this Guideline and shall not be less than the indicative minimum in Table 2-C.

The estimation of design traffic shall refer to the Traffic Impact Assessment, completed at the development application stage that quantifies the level of impact the proposed subdivision or development will have on the local traffic environment. Seasonal variations must be taken into account when determining the design traffic in accordance with Austroads Guide to Traffic

Management part 3. Furthermore short term counting stations are not supposed to be used to establish AADT on their own. Instead AADT may be estimated by multiplying the ADT obtained at Short-Term Stations by a Seasonal Adjustment Factor ideally derived at a suitable Permanent Station. Assessment reports must address this section of Austroads. Should this be unable to be addressed with a single day traffic count, data taken over a 2 week period is considered as a reasonable solution to address this.

Proprietary software programs may be used to quantify the level of impact on traffic distribution; however, the software must be a recognised industry standard and a comprehensive list of set-up parameters used to obtain results from the software is to be submitted along with the detailed design documentation.

For the purposes of determining the existing traffic volumes of roads that may impact on the proposed development, the City shall make available to the developer, where available, existing traffic count data and any other such information relevant to the development.

For pavement design calculations, consideration shall be given to the impact of construction traffic on the newly constructed pavement. It may be necessary to increase the overall pavement depth to ensure the pavement is of sufficient strength to cater for traffic loads during construction of housing, commercial buildings, future construction traffic associated with staged developments etcetera. A staged construction design approach may be adopted to manage the impact of construction traffic.

2.5.4 Design speed

The following design speed shall be adopted for the design of new roads

- For roads with posted speed less than or equal to 50km/h: the design speed shall match the posted speed;
- For roads with posted speed of 60km/h: the design speed should match the context and movement function of the street. On these streets designers should use caution when referring to Austroads guidance and ensure the guidance was intended for use on lower speed streets;
- For roads with posted speed of 70km/h and above: the design speed shall be the greater of: 10km/h above the posted speed limit and the 85th percentile operating speed[2] for the section of road being designed.

2.5.5 Design and check vehicles

Design vehicles are the largest vehicle likely to regularly operate at an intersection and shall be designed for the 5 to 15km/h design turning speed. Design vehicles shall remain within the travel lane and any line marking.

A check shall be performed using an appropriate check vehicle to demonstrate satisfactory operation and manoeuvring of larger vehicles within the road carriageway. A check vehicle may cross the road centreline and/or utilise the full width of the pavement including the parking lane and may mount a kerb provided it doesn't impact on signage, street trees or footpaths.

The radius of splays at intersections shall be determined based on the swept paths of design and check vehicles.

The Austroads design vehicles and turning path templates guide are to be used as the basis for design and check vehicles. The vehicles to be used for vehicle turning movement and intersection design calculations are shown in Table 2-H.

Table 2-H - Design & Checking Vehicles for Roads

Road classification *(see Section 2.4.2)*	Design vehicle	Check vehicle
Arterial	As required at minimum: Prime Mover and Semi-Trailer (19m); Radius 15m	As required at minimum: B-Double (26m); Radius 15m
Sub-Arterial	As required at minimum: Prime Mover and Semi-Trailer (19m); Radius 15m	As required at minimum: B-Double (26m); Radius 15m
Industrial	As required at minimum: Prime Mover and Semi-Trailer (19m); Radius 15m	As required at minimum: B-Double (26m)
Collector - residential	Design Single Unit Truck/Bus (12.5m); Radius 12.5m	Prime Mover and Semi-Trailer (19m); Radius 15m
Local – residential	Design Single Unit Truck/Bus (12.5m); Radius 12.5m	Prime Mover and Semi-Trailer (19m); Radius 15m
Access – residential	B99 passenger vehicle (5.2m); Radius 6.3m	Design Single Unit Truck/Bus (12.5m); Radius 12.5m
Sewer Pump Station	Service vehicle (8.8m); Radius 9m	-
Gross Pollutant Trap, access to retention/detention basin	Service vehicle (8.8m); Radius 9m	-

2.6 Geometric design

2.6.1 General

Designers of roads shall clearly demonstrate consideration of the following elements as a minimum:

- Smooth, safe, trafficable horizontal and vertical alignments;
- Adequate sight distance with consideration being given to the road classification requirements;
- A safe speed environment appropriate to the function;
- Safe vehicular and pedestrian access to each allotment;
- Provision for utilities and stormwater drainage;
- Access provisions and sight distance from/to each lot;
- Stopping sight distances from all locations;
- The speed environment created by the alignment;
- Provision for stormwater drainage;
- Provision for services and utilities; and

- Hydraulic analysis if the road formation is to be utilised as an overland flow path.

The geometric design of roads is to be based on the principles of Austroads Guide to Road Design Part 3: Geometric Design, and all publications referenced therein.

2.6.2 Scope of design

Road horizontal and vertical alignment designs are required to be extended a minimum of 100m beyond the extent of the subject development where there is a possibility of the road being extended or upgraded by future development stages. Where new roads intersect with existing roads, the intersection shall be designed in accordance with Section 2.10 of this Guideline.

2.6.3 Sight distance

Designers must consider Stopping Sight Distances and Safe Intersection Sight Distance in the geometric design of roads and intersections, and these shall be determined as per the procedure in Austroads Guide to Road Design Part 3: Geometric Design – Section 5 – Sight Distance.

Roads shall be designed as a minimum for car stopping sight distance based on a driver's eye height of 1.1m above the road surface and a stationary object on the road at 0.2m height. All other stopping sight distance scenarios shall be considered by the designer with engineering judgement used to consider whether those scenarios are applicable.

Reaction times shall be adopted as per below and Section 2.10.1. For a scenario not covered below, the designer shall use their judgement to adopt a suitable reaction time for the traffic volume and roadside environment.

- 1.5 seconds: Roads and intersections where drivers will be alert due to high pedestrian and/or traffic volumes and low vehicle speeds. Posted speed shall be less than or equal to 50km/h;
- 2.0 seconds: Roads and intersections that don't have high pedestrian or traffic volumes with posted speed greater than or equal to 50km/h and less than or equal to 80km/h; and
- 2.5 seconds: Roads and intersection with posted speed greater than 80km/h.

Landscaping plans shall be prepared with consideration given to sight distance requirements, as shall any proposal for "Estate Entrance Structures". Design drawings submitted for approval shall show all existing and proposed features in sufficient detail to demonstrate that appropriate sight distances are achieved.

2.6.4 Horizontal alignment and curves

Horizontal curve geometry for local and access road classifications are permitted to be designed for vehicle speeds lower than the design speed specified in Section 2.5.4 to encourage speed control in residential streets. A minimum curve radius of 25 metres in local streets should be provided.

The horizontal curve geometry for Collector roads and above shall satisfy the design speed.

For design speeds up to 60 km/hour, the use of transition curves is not considered necessary.

2.6.5 Vertical alignment

Longitudinal gradients shall be designed to comply with the following absolute limits:

Table 2-I - Absolute limits for longitudinal gradients on roads

Gradient type	Value
Maximum permissible grade on an arterial road	8.0%
Minimum permissible grade on an arterial road	1.0%
Maximum permissible grade on all other road categories	16.0%[1]
Maximum distance maximum grade is to be adopted in any one location	150m
Minimum permissible grade on all other road classifications	1.0%[2]
Maximum permissible grade adjacent to street intersections, locations of poor visibility, horizontal curves of 15m or less and at cul-de-sacs	10.0%
Maximum grade of turning circles in cul-de-sacs	5.0%

[1] Where this gradient cannot be reasonably attained the City may allow an absolute maximum gradient of 20% for a maximum of 60m on local and access roads where necessary to allow connection to an existing road. The road pavement is constructed in reinforced concrete to prevent shoving.

[2] The minimum longitudinal grade of a road may be reduced to 0.5% in circumstances where the existing topography does not permit a 1% grade being achieved across the site.

Drainage requirements on steep grades will typically involve the incorporation of drop pits and extensive piping. Developers may find it more economical to avoid the use of steep grades to negate the need for the use of such structures.

Gutters or open channel drains are to have a minimum grade of 1% and consideration shall be given to increasing the minimum grade where changes of direction or drainage concentration occur.

2.6.6 Vertical curves

Vertical curves shall be provided at all changes in grade and consideration shall be given to the combination of vertical curves with any horizontal curves. Vertical curves are to be designed in accordance with Austroads Guide to Road Design Part 3 with a maximum vertical acceleration of 0.05g to maintain driver comfort. Long length vertical curve on flat approaching grades should be avoided to minimise drainage issues associated with flat grades at the crest of the curve.

2.6.7 Superelevation

Super-elevation of curves is generally not considered necessary in built-up areas; however, if required in rural areas or roads with posted speeds exceeding 50km/h, the design of such curves shall be carried out in accordance with the Austroads Guide to Road Design Part 3: Geometric Design.

The maximum super-elevation of a curve in a built-up area shall be 4.0%. The maximum super-elevation of a curve in a rural area shall be 7.0%. The maximum superelevation of a curve in a mountainous area shall be 10%.

2.6.8 Pavement crossfall

The nominal crossfall on all pavements shall be 3.0%.

The maximum cross-fall will generally occur on super-elevated curves and road intersections, and this must be clearly indicated on design drawings.

The relative change in crossfall of kerb line and centreline is not to exceed 0.5%.

2.6.9 One way crossfall

One way crossfall will only be considered where a two way crossfall cannot be reasonably achieved due to the topography of the site. The nominal crossfall for one way crossfalls shall be 3%. Where the design of the road includes the provision of kerb and gutter as per Table 2-A, barrier kerb and gutter shall be installed on the high side of one way cross falls where dwelling stormwater outlets discharge onto the road. Flush kerb may be utilised on the low side of the road where the sheet flowing stormwater runoff flows into open space.

Consideration shall be given to the hydraulic capacity of the carriageway cross section in drainage calculations for one way crossfalls.

2.6.10 Crown offsets

In areas of difficult terrain where it is not desirable to have the crown on the centre of the road, the crown may be relocated towards the higher side of the road, provided that the new location is located at the outer edge of the travel lane or at the interface between travel lanes and parking lanes.

2.6.11 Cul-de-sacs

The radius of a cul-de-sac bowl shall not be less than 10.0 metres. The provision of stormwater drainage flow paths in cul-de-sacs, including the provision of easements or drainage reserves at cul-de-sac heads, shall be given careful consideration to avoid trapped low points for the major overland flow path.

2.6.12 Split level carriageways

If the topography of a development or subdivision necessitates split level construction of a road, the road reserve shall be sufficiently widened from that detailed in Table 2-C to include the minimum formation width as well as the provision of a median island or retaining wall.

Medians shall consist of a permanently retained batter not steeper than 4V in 1H and/or constructed of structural concrete, stone pitch or proprietary keystone blocks. Median retaining walls shall be designed by an appropriately qualified structural engineer. The crossfall of each carriageway is to be one way towards the outer carriageway edge.

Barrier Kerb shall be provided along all median edges to prevent mounting by vehicles.

Consideration shall be given to the warrant for a safety barrier along a median or retaining wall of a split-level carriageway in accordance with Section 2.9.1 of these Standards.

Lengths of split level carriageway exceeding 100m will not be permitted nor may split level carriageways traverse through intersections.

Split level carriageways are not permitted on Arterial, Sub-Arterial or Collector roads.

2.6.13 Intersections and roundabouts

For the geometric design parameters for intersections and roundabouts, refer to Section 2.10.

2.7 **Formation design**

2.7.1 Pavement design

For the design parameters of pavements, refer to Section 2.11 of this Guideline.

2.7.2 Kerb and gutter

Where required in Table 2-A or otherwise, kerb and gutter shall be designed to address drainage requirements and to adequately and safely provide both vehicular and pedestrian access to each allotment.

Where it is considered by the City to be impractical to construct an isolated section of kerb and gutter and road pavement, the City may require the developer to pay a contribution in lieu of construction, based on the estimated full cost of the works calculated by the City.

Kerb and gutter shall be of the following types depending on road classification:

- Barrier kerb and gutter (modified SA kerb and gutter) for all arterial, sub-arterial, collector, local roads, access roads in residential, commercial, industrial and special precinct areas (zoned E1 to E5) zonings except where noted in Section 2.6.9;
- Roll top kerb (modified RT kerb) for lane ways; and

Where a road carriageway is to be utilised as an overland flow path for stormwater drainage, the kerb and gutter shall be of barrier kerb and gutter (modified SA kerb and gutter) type.

2.7.3 Vegetation removal

Road reserves in urban areas shall be cleared of vegetation as required to allow construction of the proposed infrastructure, subject to environmental approval. Where it is proposed to remove any trees with a trunk diameter greater than 150mm as measured 600mm above natural surface, the location of such trees shall be shown on the design drawings and the City of Coffs Harbour shall be consulted to determine the environmental significance of the trees.

2.7.4 Batters

For rural road design, cut and fill batters in material other than rock shall not be steeper than 2H in 1V in cuttings and 4H in 1V in embankments where safety barriers aren't provided. Fill embankment batters may be steepened to a maximum slope of 2H in 1V provided a safety barrier is provided for the length of the batter that is steeper than 4H in 1V. Cut and fill batters in rural areas shall lie wholly within the road reserve, and if necessary the road reserve shall be widened to accommodate the batters.

Where a batter height in excess of 3.0 metres and a batter slope in excess of 4H in 1V is proposed, a geotechnical assessment is to be completed by an engineering geologist or geotechnical engineer encompassing all criteria required in accordance with class 1 controlled fill as per AS 4678. A maximum batter slope height and face slope is to be approved by the City. The City reserves the right to limit the maximum batter height to five metres.

The following treatments to batter slopes are required:

- Slopes of 6H:1V or flatter – topsoil and seed or turf;
- Slopes between 6H:1V and 4H:1V inclusive – topsoil and turf; and
- Slopes steeper than 4H:1V – provide treatment recommendation from a qualified geotechnical engineer for the City's approval prior to undertaking any works. Or as directed by the City.

The developer shall provide details of the proposed grass species to be used.

Where batters are located within a cutting, the upslope catchment and flow paths shall be considered to avoid channelised sheet flow down the face of the batter. If catch drains are provided at the top of batter to intercept runoff, they shall be concrete or other proprietary lining type catch-drains. The type and location of all batter catch drains shall be clearly shown on the design drawings.

Where any cutting or filling in an existing road reserve may undermine or compromise the structural integrity of an existing structure either in the road reserve or on the adjacent land, a structural retaining wall shall be required to retain either the existing structure or the batter. Retaining walls on public land shall be designed in accordance with Section 7.5.

2.7.5 Road embankments

Where road embankments exceed two metres in height as measured vertically from the top of the batter to the toe, the requirement for safety barrier fencing shall be determined in accordance with Section 2.9.1 of these Standards.

Notwithstanding this, safety barrier fencing shall not be used on road boundaries adjacent to residential allotments in built-up areas.

2.7.6 Formation encroachment into lots

Where road RDS 1 or RDS 2 cut or fill batters cannot be accommodated within the road reserve, the batters may extend into proposed lots. The grade of batters within a lot shall be minimised. Note that footway crossfalls are to be in accordance with Section 2.5.2.5**.**

2.7.7 Driveways and property accesses

Driveways and property accesses shall be designed in accordance with the driveway and property access procedure in Appendix A of Part 2.

2.7.8 Staged road construction

Where roads are constructed in stages of a subdivision, a permanent barricade (D4-5 sign) conforming to AS1742.2 shall be constructed at the end of the road to warn motorists of the termination of the road and to prevent their passage beyond.

A temporary bitumen sealed cul-de-sac designed in accordance with Section 2.11 shall be designed and constructed at the end of staged road developments. In cases where the design for the stage includes a stub road servicing single corner lots, the City may approve the stub road without the requirement for a temporary cul-de-sac, provided that it is demonstrated by the developer (either by inclusion of concrete driveways on the CW plans or by another similar method) that access to the corner lots will be achieved from the primary road at the time of construction.

Temporary cul-de-sacs shall be dedicated as public road reserve or included under a Right of Way on the plan of subdivision. This Right of Way shall be extinguished when the road is extended into the next stage of the development. The Right of Way shall be sized to allow for motorists and garbage trucks to turn around completely within it. Pavements under temporary cul-de-sacs are to be constructed as per the approved pavement design for the road leading up to the cul-de-sac.

A temporary bitumen link between two road stubs may be constructed as an alternative to a temporary cul-de-sac. Temporary link roads are to be maximum 70m long and shall be constructed as per the approved pavement design.

Barricades and temporary pavements are to be removed only upon completion of construction of the adjoining stage.

2.8 Local area traffic management - regulatory signs

Street design should promote vehicular speeds that are appropriate to the context by street geometry and alignment rather that by speed control devices where possible.

Local area traffic management is concerned with the planning and management of the usage of road space within a local traffic area, often to modify streets and street networks which were originally designed in ways that are now no longer considered appropriate to the needs of residents and users of the local area. It involves the use of physical devices, streetscaping treatments and other measures (including regulations and other non-physical measures) to influence vehicle operation, in order to create safer and more pleasant streets in local areas. In greenfield sites, good street design should be achieved through self-explaining streets and context-sensitive urban design.

All traffic signs, pavement markings, pedestrian and traffic management devices must be designed and implemented in accordance with the relevant Transport for New South Wales (TfNSW) Transport Standards and Guidelines, Austroads Design Guidelines and Australian Standards.

The City shall refer all regulatory traffic related matters and requests for changes to speed zones to the Local Traffic Committee (LTC) prior to exercising its delegated functions under the Road Transport (Safety & Traffic Management) Act, 1999 and the Roads Act, 1993.

Where Local Area Traffic Management (LATM) devices are required, these devices shall be designed and installed in accordance with Austroads Guide to Traffic Management – Part 8, and Australian Standard 1742.13. The type and location of any LATM devices shall be clearly shown on the design drawings. LATM devices should not be used as isolated treatments, but rather should ideally be installed as a consistent area-wide traffic management scheme in a local area. Devices should be placed as Figure 2 and Table 2-J.

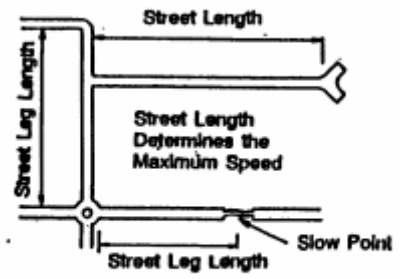

Figure 2 – LATM spacing layout

Table 2-J - LATM spacing requirements

Design Speed (km/h)	Street Leg Length (m)
25	40
30	75
35	100
40	120
45	140
50	155
60	180
Note: End condition – 20km/h or less For Gradients of 5 to 10% For gradients over 10% add 10km/hr	

End conditions and intersection treatments reducing vehicle speed to 20km/hr or less may include:-

- T-intersection;
- Roundabout;
- Bends (approximately 90deg of radius 9m or less); and
- Traffic control devices (e.g. slow points of appropriate design.

Traffic control facilities and prescribed traffic control devices may be authorised for use on a road or road related area, whether a public road or on private land, only by TfNSW or the City. In addition, traffic may be regulated for various purposes by means of notices or barriers erected by a road authority.

Coffs Harbour Local Traffic Committee review and TfNSW approval is required for all LATM devices. Speed zones and special use areas (shared zone, high pedestrian activity area) must be authorised by TfNSW. The developer shall contact TfNSW and the NSW Centre for Road Safety for details on the requirements.

2.9 Ancillary facilities

2.9.1 Safety barrier

Roadside hazards and any mitigation treatment shall be assessed in accordance with the risk assessment procedure outlined in Austroads Guide to Road Design, Part 6, Safety and Barriers. The Network Roadside Risk Intervention Threshold score to be adopted for the Coffs Harbour LGA is applicable to urban and rural environments and shall be taken as:

- Threshold score for existing roads: 2.0; and
- Threshold score for new roads: 1.5.

Where the hazard risk score exceeds the threshold value, mitigation treatments including the use of safety barriers shall be assessed.

Where safety barriers are required to mitigate a roadside hazard, they must be compliant to MASH Test Levels for the appropriate speed environment. For MASH TL3 safety barriers, the minimum barrier height shall exceed 750mm.

2.9.2 Bus Routes

The design of bus routes shall be in accordance with the TfNSW guidelines for Public Transport Capable Infrastructure in Greenfields Sites. Bus routes may vary over time, thus it is important for the road hierarchy to adequately cater for buses. The road width specified in Table 2-C assume that only collector roads or higher classification roads are required to carry buses.

Collector roads within R2 and R3 zoning do not have edge lines, thus the parking lane is not defined on the road carriageway. Although the parking lane width for these roads is slightly less than the required 3 metres, the combined travel lane and parking lane width provide sufficient space for a bus to pull over and passenger vehicles to safely pass, which the City deems to satisfy this parking lane width requirement.

Collector roads within R1 zoning are considered low volume roads and the City does not require compliance with the 3 metres parking lane width given the traffic volumes are expected to be low which would give ample opportunity for passenger vehicles to pass a bus that has stopped to pick up passengers.

The City classifies the Coffs Harbour LGA as a Major Regional Centre within Regional NSW to determine the frequency of bus stops. The frequency of bus stops for a major regional centre requires 85% of households to be within 800m of a bus stop.

A single bus shelter shall be provided on collector roads. Multiple bus shelters or bays may be required sub-arterial and arterial roads and shall be determined on a case by case basis in consultation with the City.

2.9.3 Street blades

Street blades are to be designed, manufactured and erected in accordance with Australian Standard 1742.5 Part 5 and the City Standard Drawing 200 series.

All street blades shall be reflectorized as per Clause 2.7 of AS1742.5.

The installation of community facilities signs shall not be permitted without the prior approval of the Group lead.

2.9.4 Sign posting, line marking and guide posts

The design, location and installation of signs, line markings and guide posts shall be in accordance with Australian Standard AS1742 Part 2. The location of signs, line markings and guide posts shall be shown on a dedicated design plan.

The use of thermoplastic pavement marking is to occur where line marking is heavily traversed by vehicles such as intersection stop and hold lines and on concrete pavement.

Dividing lines (S1, BS and BB) shall be included on Collector, Sub-Arterial and Arterial roads.

Edge lines (E1) shall be included on Sub-Arterial and Arterial roads. The use of edge lines on Collector roads shall be assessed on a case by case basis.

Raised Reflective Pavement Markers (RRPM's) shall be provided in accordance with AS1742.2 for Sub-Arterial and Arterial roads. The use of RRPM's on Collector roads shall be assessed on a case by case basis.

2.9.5 Streetlighting

Where required in Table 2-A or otherwise, street lighting shall be provided on roads and designed in accordance with the Australian Standard for Public Lighting AS 1158. The developer must appoint a suitably qualified and experienced Level 3 ASP consultant to liaise with the City for the approval of the street lighting and electrical reticulation. The principal consultant must hold a professional indemnity insurance in accordance with section 1.10.1 of this document.

Streetlights shall be designed to maximise energy efficiency. Streetlights shall generally be of the following types:

- Nominal 17 Watt LED for all Category P streetlighting; and 250 Watt High Pressure Sodium for Category V lighting when LED technology is not suitable.

Where practical, streetlights should be located adjacent to the property boundary in a staggered or alternating pattern on either side of the road reserve, and designed such that the light is directed towards the centre of the road reserve whilst ensuring that pedestrian facilities such as formed footpaths benefit from the light.

The following factors should be considered when determining the street lighting alignment:

- The potential for vehicle collision on built to boundary lots and rear access lot driveways;
- The pole type shall be installed in accordance with the requirements of the relevant Australian Standards having regard for the pole location and speed environment;
- Locate streetlights in line with abutting property boundaries or on truncation points at intersections. In cul-de-sac locations, the alignment is measured along the line projected at right angles to the lot boundary through to the kerb;
- Locating poles in cul-de-sac adjacent to narrow property frontages is undesirable due to possible conflict with adjoining driveways;

- The preferred configuration of lighting at a roundabout is for the light poles to be located on the approach side of each intersection Street without poles in the central island. Street light poles must be located as far as practical away from the intersection. The City would only consider the installation of central island lights if the aforementioned preferred lighting arrangement cannot be achieved, then the poles are of the cantilever (pivot arm) type and satisfactory maintenance vehicle access is provided clear of landscaping;
- The interaction of the street lighting with street trees should be given careful consideration;
- The design of the subdivision or development shall include consideration of the requirements for the provision of street lighting at intersections, pedestrian crossings and other areas of high pedestrian or vehicular traffic; and
- Where a pathway is only located on one side of the street, the lighting is to be provided along the same side of the street as the pathway.

Provision of access for maintenance of lighting is to comply will the specific requirements of the energy provider.

The City does not support the installation of glare shields on new streetlights. This position is taken for several reasons:

- Uniform Lighting Standards: The City adheres to uniform lighting standards across new subdivisions to ensure consistency and safety in public spaces;
- Public Safety: Glare shields may reduce visibility and compromise public safety by creating areas of uneven lighting and potential blind spots; and
- Community Impact: Installing glare shields on street lights in residential areas can impact the overall aesthetics of the neighbourhood and may not be supported by all residents.

Table 2-K provides the required street lighting sub category based on the road classification.

Table 2-K – Streetlighting category for road classification

	RDS1	RDS2	RDS3
Footpath*	PP5	PP5	PP5
Bicycle path*	PP5	PP5	PP5**
Shared path*	PP4	PP4	PP5**
Arterial Road	V3	V3	As advised by The City
Sub-arterial Road	V5	V5	As advised by The City
Collector Road	PR3	PR3	PR5
Local Road	PR5***	PR5*	PR5
Access Road	PR5***	PR5*	PR5

*Lighting sub category of paths shall be the appropriate PP category if the path is not adjacent to a road that requires lighting. If the path is adjacent to a road that requires lighting, the appropriate PR lighting sub category shall be adopted for the road and path.

*** PR3 if road contains a shared path.

**Street lighting in RDS3 locations is only required if the road requires lighting.

2.9.6 Provision of utilities

2.9.6.1 *Location of utilities*

The provision of utilities within the road reserve shall be as per the City Standard Drawing 200 series. Utilities shall not be installed beneath the floor or batters of open channel drains or other drainage structures.

The minimum corridor widths and footway allocations for utilities and services are as per Table 2-L.

Table 2-L - Utility and service corridors and offsets

Utility or service	Minimum corridor width (mm)	Corridor offset from (mm)	Corridor offset to (mm)
Street Lighting	1000	Property Boundary	1000mm from Property Boundary
Electricity Distribution	1000 *Note 2 and 3*	Property boundary	1000mm from property boundary
Natural Gas	N/A	N/A	N/A
Telecommunications	600 *Note 1*	1000 from property boundary	1600mm from property boundary
Sewer	As per easement requirements. See Section 5.5.9	Property boundary	As required into private property
Street Tree	1100 *Note 3*	Street tree to be 1150mm from invert of kerb	
Water	1000	Centre of water main corridor to be 2800mm from property boundary	
Concrete footpath	1500 min	1000mm from property boundary	2500mm from property boundary

- Note 1: The corridor width for electricity and telecommunications is generally based on the provisions of the NSW Streets Opening Conference Guide to Codes and Practises for Streets Opening and amended for the adopted verge width.
- Note 2: The electrical allocation is 1000mm in width and extent from the property boundary. The allocation includes street lighting poles as well as low voltage and high voltage cables. Street lights may be located adjacent to the property boundary so they are clear of electrical cables. This allocation width is based on the Essential Energy standard drawings.
- Note 3: The separation distance of any utilities, services or other infrastructure from a street tree shall be no less than 1000mm as measured from the centre of the tree to the centreline of the service.

2.9.6.2 *Utilities road crossings*

All trenches and conduits under roads shall be installed at a grade of not less than 0.5% and shall be clearly marked on design drawings.

Utility crossings under roads shall be completed prior to construction of the pavement base course layer. Where utilities are to be installed after construction of the pavement is complete, these shall be underbored with minimal disturbance to the pavement.

Where the diameter of the utility conduit is greater than 250mm, open trenching shall be permitted. Re-instatement of the pavement in open trenches shall be as per 2.11 of these Guidelines. The provision of utilities in shared trenches shall not be permitted unless the prior approval of the relevant utilities authority is obtained.

All road crossings in new and existing subdivisions shall consider the impact of the road crossing being either skewed or perpendicular to the centreline of the road in relation to design, maintenance of the service and use of the road. Road crossing of existing roads shall be underbored regardless of the alignment.

2.9.6.3 *Electricity distribution utilities*

All electrical power shall be distributed within a subdivision as per the requirements of Table 2-A or DA consent. Consultation by the developer with the appropriate electricity distribution authority regarding the provision of electricity distribution shall be required.

Substations are to be located on private property and not in road reserves or the City's reserves.

Electrical plans shall be submitted to the City for review. The City will approve draft plans prior to final approval by the Electrical Authority. Any revisions to the electrical plans shall be submitted to the City for review prior to construction.

2.9.6.4 *Electricity road crossings and transmission easements*

Where proposed roads intersect with existing or proposed electricity transmission easements, consultation with the appropriate electricity distribution authority regarding acceptable minimum ground clearances to the distribution infrastructure within the easement shall be necessary.

If a subdivision is created over an electricity easement, The Electrical Authority may require the provision of vehicular access along the easement.

2.10 Intersections

2.10.1 General

The design of intersections shall consider the following criteria:

- Safe and efficient movement of all likely users of the intersection (eg vehicles, pedestrians and cyclists) with priority between users dependent of the local context and function of the intersecting roads/streets;
- The efficient movement of traffic through the intersection and distribution of this traffic throughout the development or subdivision where vehicle movement is a priority;
- The relationship between the intersection type and the horizontal and vertical alignments of the intersecting roads;
- Analysis and treatment of conflict points created by traffic movements through the intersection;
- The safety of motorists, pedestrians and cyclists negotiating the intersection;
- Provision for pedestrian movements;
- The speed environment created by the intersection; and
- The amenity and location of the intersection.

The type of proposed intersections should be selected in accordance with the Austroads Guide to Traffic Management – Part 6 and designed according with Austroads Guide to Road Design.

Intersections shall generally comprise of T-junctions or staggered T-junctions. Where T-junctions are considered impractical, four-way intersections or cross-intersections may be proposed; however, these shall be controlled by the most suitable traffic management devices as identified in the Traffic Impact Assessment or other methods, based on warrant.

Where staggered 'T'-junctions are proposed, the distance between the centrelines of the minor roads shall be located apart by a minimum distance of 2 x SSD (Stopping Sight Distance) for the adopted design speed calculated using a 1.5 second reaction time.

Roads shall not be designed to intersect at an angle less than 70º.

All proposed junctions with classified roads shall have a design reaction time of 2.5 seconds when calculating intersection stopping distances.

Landscaping plans, including any proposed "Estate Entrance Structures", shall be prepared for intersections with consideration given to sight distance requirements, and all landscaping and vegetation shall be designed to require minimum ongoing maintenance. Estate entrance structures shall be located within private property, not the road reserve and shall be subject to development consent.

Design plans shall show all existing and proposed intersection features in sufficient detail to demonstrate that appropriate sight distances are achieved.

2.10.2 Design traffic

The quantity, nature and distribution of traffic shall be determined as per the requirements of Section 2.5.3.

2.10.3 Warrants for intersection treatment type

Warrants for the selection and use of intersection treatment types shall be determined using the procedure outlined in Austroads Guide to Traffic Management, Part 6, Section 2.3.6 - Warrants for BA, AU and CH Turn Treatments where one or more of the following design criteria are met:

- All arterial and sub-arterial roads;
- The design speed exceeds 80km/h for built-up areas or is equal to or greater than 100km/h in rural developments;
- The design traffic for either the minor or major road exceeds 1000 AADT; and
- A four-way intersection or cross-intersection is proposed.

For existing intersections, the level of service achieved by the intersection for the design traffic generated by the development or subdivision shall be clearly demonstrated as per the method described in the Austroads Guide to Traffic Management.

For new intersections, the intended level of service provided by the proposed intersection treatment type selected shall be clearly demonstrated as per method described in the Austroads Guide To Traffic Management.

When considering levels of services provided by intersections, the designers must consider the traffic generated following the ultimate growth of the development or subdivision.

2.10.4 Vehicle turning movements

Notwithstanding the requirements of the Austroads Guide to Road Design Part 4, vehicle turning movements at intersections are to be designed using the Austroads Vehicle Turning Templates.

Sufficient carriageway width shall be provided such that the swept path of a Design Vehicle (as per Table 2-H) making a turning movement is contained wholly within the travelled lane. The design vehicle must be able to make a turning movement in a single forward motion without the need to use vehicle accesses, driveways, parking lanes or lanes in the opposite direction of travel.

It is also necessary to check the proposed road layout using the check vehicle template to ensure that occasional use by vehicles larger than the chosen design vehicle is viable. In this case, the check vehicle may cross the road centreline and/or utilise the full width of the pavement and may mount a kerb.

2.10.5 Roundabouts

Where a roundabout is either proposed or required to be constructed as an intersection treatment type, it shall be designed in accordance with the Austroads Guide to Road Design Part 4B.

Where the centre median island of a proposed roundabout is to be landscaped, the type of landscaping proposed shall be shown on the design drawings and included in the landscaping plan, and shall be designed to require minimum maintenance. Any proposed roundabout landscaping shall not interfere with the design sight distances of the roundabout.

2.10.6 Signalised intersections

Where a signalised intersection is either proposed or required to be constructed as an intersection treatment type, it shall be designed in accordance with the Austroads Guide to Road Design Part 4A subject to Local Traffic Committee requirement outlined in Section 2.8 and TfNSW approval.

2.11 Pavement design

2.11.1 General

This Section outlines the minimum requirements for the design of road and carpark pavements. Flexible and rigid pavements are permitted subject to the requirements of Section 2.11.2 being met. Where a bound flexible pavement is proposed, testing shall be undertaken by the developer prior to commencement of construction to demonstrate the UCS of the bound pavement will not exceed 1.5 MPa.

2.11.2 Pavement design life

Pavement designs are to be undertaken based on a minimum design life in accordance with Table 2-M.

Table 2-M - Pavement design life

Type of pavement	Minimum design life
Flexible pavements, either unbound granular or containing one or more modified layers	40 years
Segmental block pavements (pavers)	40 years
Rigid pavements (concrete)	40 years

The developer shall provide evidence to the City that the proposed pavement achieves the required design life. This evidence may be in the form of excel spreadsheets, outputs from commercially available software or other methods where agreed with the City's representative.

2.11.3 Pavement design procedure

Pavement design criteria is to include but not be limited to those listed in Table 2-N.

Table 2-N - Pavement design criteria

Element	Applicable section
Projected traffic loadings	2.11.4
Subgrade evaluation	2.11.5
Environmental Factors	2.11.6
Materials	2.12
Construction methods	Specification

A flexible pavement design report shall be prepared by a person with suitable experience in geotechnical investigations or an Engineer, and shall include the following as a minimum:

1. Evaluation and reporting of the subgrade material;
2. Subsoil drainage conditions;
3. Design Parameters used in accordance with these Guidelines;
4. The calculated nominal layer thicknesses;
5. Details of the materials to be used in the pavement construction; and
6. Wearing surface type and properties.

2.11.4 Design traffic and pavement design parameters

The Design Traffic for use in pavement design calculations shall be determined as per Section 2.5.3.

The parameters used in the pavement design shall be determined as outlined in

Table 2-O - Pavement design parameters

Parameters	Value
Design traffic (AADT)	Section 2.5.3
Percentage of heavy vehicles	Section 2.5.3
Growth rate	Determined by traffic modelling or a default value of 1.2%
Number of Heavy Vehicle Axle Groups (NHVAG)	Preferably from tube count data of a similar street. If no traffic counts are available, table 12.2 of AGPT Part 2 may be utilised
Damage Index (ESA/HVAG)	Urban roads: Table 12.2 of AGPT Part 2. Rural roads: Either determined from traffic count data or the TfNSW presumptive value

2.11.5 Subgrade evaluation

Subgrade strength characteristics used in the pavement depth design shall be determined by sampling, testing and reporting in accordance with AS1289 Method of Testing Soils for Engineering Purposes.

Sampling shall be along the road alignment and randomised in accordance with AS1289.1.4.1. A minimum of 2 sample locations shall be tested for each development or project. The rate of testing shall be no less than 1 test for every 400m of road pavement.

Subgrade material testing and reporting shall consist of the following:

- California Bearing Ratio (CBR);
- Linear Shrinkage of sampled material; and
- Shrink – Swell Index.

2.11.6 Environmental Factors

The following environmental factors shall be considered during the pavement design process:

- The identification and treatment of ground water;
- Natural drainage including sub-soil drainage;
- The presence of acid sulphate soils;
- The presence of erosion prone soils such as silt, buried landfill and waste dumps; and
- The impacts of appropriate preventative or remedial treatments as necessary.

2.11.7 Pavement thickness design

A compliance survey shall be undertaken at subgrade level to verify the design pavement thickness will be achieved. Three readings will be taken at each chainage marker; one on each side of the road (on the line of the lip of kerb/road shoulder), and one at the centreline. Subgrade levels shall be displayed in tabular format.

The submission of subgrade conformance levels is to be included as a Hold Point prior to importing of sub base material.

Notwithstanding the above, the compliance survey shall be undertaken by a registered surveyor or an engineer and a copy of the compliance survey and subgrade level table can be submitted at the same time as the WAE plans (at the developer's risk); however, it is the preference of the City that the compliance survey is submitted separately and prior to the WAE plans. The compliance survey shall demonstrate, as a minimum, that the pavement thickness (as per the pavement design) is achieved.

The nominal pavement design shall be determined using the empirical procedure outlined in Section 8.3 of Austroads Guide to Pavement Technology Part 2.

Pavements with an asphalt wearing surface 50mm or thicker may have the asphalt thickness included in the overall pavement depth, but shall not have the asphalt thickness included in the depth of base-course material.

If the design CBR determined for the subgrade is less than the minimum CBR 3, then the following is required:

- Replacement of low strength subgrade for a depth of 300mm with minimum CBR 15 replacement material; and

- Re-design the pavement based on a subgrade CBR 3 in accordance with Austroads Guide to Pavement Technology Part 2.

See Table 2-Q for minimum pavement thickness of each respective layer if included in the design.

Alternative designs incorporating geogrids will only considered in exceptional circumstances.

2.11.8 Pavement treatment for granular overlay

Where an existing pavement is proposed to be treated with a granular overlay, if the existing pavement has a thin bituminous seal, the existing seal shall be removed or broken up to ensure that water is not trapped in the overlay.

2.12 Materials selection

2.12.1 Granular pavement material

Details of the material source and properties proposed for use in the pavement shall be submitted as part of the pavement design report. The following information is required as a minimum:

Table 2-P - Pavement Materials

Property
Material source
Material type
Representative CBR value
Particle size distribution
Atterburg limits

Materials proposed to be used in the pavement shall meet the requirements of Table 2-Q.

Table 2-Q - Pavement materials limits

Pavement Layer	Property	Required value of Property	Minimum Thickness	Compaction Requirements
Subgrade **Top 0.15m** **Below 0.15m**	-	-	-	 100% Standard 95% Standard
Bridging layer (where required)	CBR	Minimum 15	300 mm	98% Standard 95% Modified
	Plasticity Index (PI)	Minimum 23		
Sub-base course	CBR	Minimum 30	150 mm or 3 × aggregate size	98% Standard 95% Modified
	Plasticity Index (PI)	Maximum 12		
Base course	CBR	Minimum 80	100 mm	100% Standard

	Plasticity Index (PI)	Maximum 6		98% Modified
All layers	Particle Size Distribution	Material is to be classed as "well-graded granular material"		

2.12.2 Wearing surface

2.12.2.1 *Roads with asphalt wearing surface*

Where a road is to have an asphalt wearing surface as specified in Table 2-A, it shall be dense graded asphalt and consist of a minimum asphalt thickness and aggregate size of:

- Access and local roads: 30mm AC10;
- Collector and sub arterial: 40mm AC10 or 42mm AC14 ; and
- Industrial and commercial: 50mm AC14.

The aggregate size to be used shall be confirmed as being suitable by the asphalt supplier based on the design loading on the road.

Asphalt mix designs prepared in accordance with the AAPA National Asphalt Specification, including NATA certified test reports of previous applications shall be submitted as part of the pavement design report.

Pavements that are designed with an asphalt wearing surface shall have a cutback bitumen primerseal applied prior to application of the asphalt. The primerseal shall consist of the requirements in Table 2-R.

Table 2-R - Primerseal design

Element	Type required	Conformance standard
Binder	As per pavement design report	AS2157
Aggregate	Minimum 7mm. 10mm also acceptable	AS2758.2

The primerseal is to extend full width between kerbs and the bitumen shall be applied to the kerb/pavement interface as well as the lip of kerb. Care should be taken to ensure no bitumen is applied to the face of kerb or channel.

A seal design consisting of the proposed aggregate and binder sources and properties and the application rates for both shall be provided to the City prior to works commencing.

Application of asphalt wearing courses shall only be permitted where it can be clearly demonstrated that all volatile compounds from the primerseal have evaporated.

2.12.2.2 *Roads with bitumen seal*

Where a road is to have a sprayed bitumen seal wearing surface as specified in Table 2-A, the seal shall conform to the requirements of Table 2-S.

Table 2-S - Bitumen seal design

Element	Type required		Conformance standard
	Rural	Urban	
Type of seal	Two-coat bitumen seal		N/A
Binder	Cutback bitumen either C170, C240 or C320		AS1357
Aggregate - 1st application	Nominal 14mm	Nominal 7mm	AS2758.2
Aggregate – 2nd application	Nominal 14mm	Nominal 7mm	AS2758.2

A seal design consisting of the proposed aggregate and binder sources and the application rates for both, including the design parameters used to determine these rates, shall be provided to the City. The seal design shall also detail the method of application of the seal, including any proposals to undertake both applications on the same day.

Bitumen sealing shall extend the full width of the carriageway, including shoulders and parking areas.

2.12.2.3 *Roads with unsealed gravel pavement*

Where a road is to have an unsealed gravel wearing surface as per Table 2-A, the wearing surface shall have the following desirable characteristics:

- Skid resistance;
- Smooth riding characteristics;
- Well-graded with a maximum size of 26mm;
- Cohesive properties;
- Resistance to ravelling and scouring;
- Wet and dry stability;
- Low permeability; and
- Load spreading ability.

The wearing course material used for unsealed roads shall also conform to the requirements of Table 2-T.

Table 2-T - Gravel wearing surface design

Sieve size (mm)	Percent passing
55	100
37.5	100
26.5	100
19	90 – 100

2.36	35 – 65
0.425	15 – 50
0.075	10 – 40
Plasticity	Maximum 12

Details of the proposed material to be used in the construction of the wearing surface of unsealed roads shall be provided to the City for approval prior to works commencing.

2.12.2.4 *Intersections and roundabouts*

Consideration shall be given to the selection of the wearing surface for intersections and roundabouts, particularly for high stress environments where the design traffic includes a high percentage of heavy vehicles.

As a minimum, all roundabouts shall be surfaced with a minimum nominal 40mm thick layer of AC14 dense graded asphalt containing a polymer-modified binder. The wearing course for roundabouts shall extend to the commencement of the central splitter islands at each approach. The wearing course for intersections shall extend 30m into each intersection approach.

Mix designs for roundabouts shall be prepared and submitted in accordance with Section 2.12.2 of this Guideline.

2.12.2.5 *Permeable Pavements*

Permeable pavement shall comply with the following:

a) Is limited to private driveways and parking areas;
b) For private driveways is limited to that serving a maximum of two dwellings:
c) Cannot be used in traffic lanes between parking space unless serving a maximum of two dwellings;
d) Must be concrete or paver based (non-plastic based) product with a minimum 50% surface area;
e) Must have a stable finished surface such as grass (loose gravel surfaces are prohibited);
f) Must be installed in accordance with the manufacturer's recommendations; and
g) Shall be omitted from any water quality and quantity calculations.

2.12.3 Pavement cross section

2.12.3.1 *Roads with kerb and gutter*

The pavement sub-grade and sub-base layers shall be designed to a minimum 500mm behind the invert of kerb or nominal inside face of kerb for a flush kerb, see the City Standard Drawing 200 series.

2.12.3.2 *Roads without kerb and gutter*

All pavement layers shall be designed for the full width of the carriageway, including parking lanes and shoulders.

Where pavements are constructed on formed batters, the pavement layers shall extend the full width of the batter.

2.12.3.3 *Sub-soil drainage*

Sub soil drainage lines shall be provided on both sides of the pavement where a kerb is provided or where the subgrade is considered to be reactive or where a geotechnical engineer deems it necessary. The design of sub soil drainage shall be in accordance with the Austroads Guide to Pavement

Technology Part 10 and in accordance with the City Standard Drawing 300 series. The type and location of all subsurface drainage systems shall be clearly shown on the design drawings.

2.13 APPENDIX A – Driveway and property access procedure

CITY OF COFFS HARBOUR

Driveway and Property Access Procedure

2.13.1 Introduction

This driveway and property access procedure is intended to assist:

- Contractors;
- Developers;
- Builders;
- architects, engineering consultants, and building designers;
- property owners; and
- internal staff.

Implementing the policies and standards adopted by the City of Coffs Harbour (the City) concerning driveways and their construction.

This manual has also been prepared to ensure that all driveway works are completed safely and consistently to reduce risks associated with public liability and promote asset longevity.

Under Section 138 of the *Roads Act 1993*, the City is the nominated Consent Authority for all works within the road reserve on local roads in the municipality, including driveways from the boundary to the road. The City must approve and inspect all driveway works within public road reserves to endorse compliance with the relevant standards, policies, and legislative requirements to protect the community from unnecessary hazards arising from non-compliant driveways.

Typical problems that appear at the time of inspection by the City include:

- incomplete construction of the driveway;
- poor finishing;
- trip hazards from incomplete backfill along the edge of a driveway;
- damage to the kerb and roadside;
- building over the City infrastructure (e.g. manholes, hydrants);
- scraping of vehicles' undersides;
- incorrect grades; and
- failure to remove rubbish from the site.

2.13.2 Advice relating to driveways

2.13.2.1 *To owners, builders, developers, certifiers*

The owner is responsible for engaging a contractor/builder and undertaking reference and licence checks through the NSW Office of Fair Trading to determine their suitability for the job.

Any works in a road reserve carried out without consent, and an inspection from the City may be deemed unapproved/unauthorised and subject to further action. This may include rectifying or removing the unauthorised works at the applicant/owner's cost. In addition, reinspection fees may be applied if additional inspections are required.

Any non-compliant works substantially varied from the specification must be rectified before a compliance notice is issued.

Therefore, it is recommended that the owner withhold final payment to contractors until the City has issued a Compliance Notice.

2.13.2.2 *Development procedure*

Driveway Applications made to the City are consistent, where applicable, with the relevant approval (e.g. Development Application (DA) consent from the City) for the development works associated with the proposed driveway.

Note: certifiers of complying and development certificates (CDCs) must ensure their obligations under the *State Environmental Planning Policy (Exempt and Complying Development Codes)* 2008 are fulfilled by having written consent (via a NOTICE OF DETERMINATION – DRIVEWAY ACCESS CERTIFICATE) received from the City for the building of any kerb, crossover, or driveway before the issuing of a CDC. Driveway Applications will not be processed where a CDC has already been issued.

2.13.2.3 *Application Procedure*

Driveway application

The proponent must lodge a 'Driveway Application' form with the City and pay the application fee (the City's current fees and charges schedule). Note: the owner must sign this application form giving consent to the works.

** No construction works in the road reserve shall commence until the Applicant has received notification that the Driveway Application has been approved by the City and a Consent Notice has been issued to the Applicant.

The proponent must ensure the works are inspected before pouring concrete (i.e. at the formwork stage/reinforcement) and again after the works if required.

** The City cannot issue a Notice of Completion unless the City considers the structure to meet the City requirements.

**A copy of the concrete docket confirming 32 MPa or site inspection of completed sealing works is required before a Compliance Notice can be issued.

Processing time for driveway applications

The target times for processing a driveway application, from the time it arrives at Customer Service to it being processed is 3 to 4 weeks.

Please note that the Driveway application process may take longer in times of high demand or if insufficient details are provided in the application.

Flowchart for new driveway works

Checklist for driveway applications

Every driveway application must demonstrate compliance with the principal requirements listed in Section 3.1 and include the following at a minimum:

- a compliant long section of the driveway;
- the proximity of the driveway to the City's assets and utilities compliant with the City's suite of Standard Drawings;
- the surface finish of the driveway;
- width of layback kerb and driveway crossover;
- the orientation of the driveway crossover to the road/kerb and gutter;
- if applicable, any existing driveway laybacks/crossovers; and
- the location of the driveway relative to the nearest side boundary.

2.13.3 Design specifications for driveways

2.13.3.1 *Principal requirements for driveways*

A driveway is used to provide vehicular access from the road carriageway to properties and must meet the following objectives:

a) Provide appropriate grades for the passage of most common vehicles in accordance with the relevant Australian Standards;
b) Provide reasonable grades for pedestrian traffic along the footpath;
c) Compliment and support the drainage function of the kerb and gutter;
d) Take account of existing property levels and existing or proposed road levels;
e) Adequately support reasonably anticipated vehicle loads;
f) Provide a durable, low-maintenance, all-weather surface;
g) Provide a safe surface for the passage of vehicles and pedestrians;
h) Provide a surface with a visually pleasing appearance that blends in with the streetscape;
i) Provide a surface that can be conveniently, successfully, and economically restored if opened for the provision of services or public utility mains; and
j) Avoid restricting or impeding the function of, or access to, the City utilities and services, including, but not limited to, stormwater pits, sewer manholes, hydrants, kerb outlets and water path boxes.

2.13.3.2 *Determining driveway levels*

Each site has constraints and/or considerations for determining driveway levels. The proponent is encouraged to discuss with the City any variations of these levels from the City's suite of Standard Drawings before submitting an application. Driveways shall be designed to accommodate a B99 vehicle entering and exiting the site in accordance with AS2890.1:

1) Changes in grade between sections shall not exceed 15% for sags or 12.5% for crests;
2) The minimum length of transitions shall be 2.8m for sags and 1.4m in length for crests; and
3) Ideal maximum grade shall be 25% (1 in 4).

Any exceedance from the above will require a detailed design using the above indicated template.

2.13.3.3 *Driveway widths and orientation*

Driveway crossover dimensions

The width of driveway crossovers shall be as follows based on the type of kerb

	Residential (Urban and Rural)		Industrial	
Kerb Profile	**Minimum Width (m)**	**Maximum Width (m)**	**Minimum Width (m)**	**Maximum Width (m)**
Roll Kerb	3	6	4	As Approved
Barrier Kerb	3	5	4	As Approved
Edge Strip	3	6	4	As Approved
No Kerb	3#	5.4#	7*#	13*#

* These widths are indicative only and subject to site suitability. Different widths may be specified in the driveway application.

Refer to the City standard drawing 200 series for more details.

For formed driveways, refer to the City's DCP for driveway widths.

Note: Required side splays (wings) widths are in addition to the above indicated widths. Refer to the relevant standard drawings for side splay widths.

Driveway crossover orientation

Driveway crossovers must be perpendicular to the road carriageway.

Other orientations may be used to meet site constraints or suit design vehicle movements to the City's satisfaction. Reasons and supporting evidence for other orientations are to be provided with the driveway application.

Note – localised thickening and/or additional reinforcement may be required if acute angles are proposed.

Pipe culvert access crossing

Where the City recovers pipes from access culverts during construction and maintenance, the City:

- Will not provide the property ratepayer with a rebate regarding the pipes recovered from the driveway access crossing, regardless of whether the adjacent landowner or ratepayer previously paid for them; and
- may offer the pipes to the adjacent owner or ratepayer at the time of removal, subject to no financial burden to the City.

Where the City is faced with designing a driveway access crossing across drains that are in excess of a standard access pipe, the City:

- May limit the charge to the landowner or ratepayer;
- Will provide a particular crossing over the drain, regardless of the culvert size required to accommodate the flow in the drain; and
- Will limit the charge to the landowner or ratepayer to the current charge for a 600mm diameter pipe access culvert.

2.13.3.4 *surface finishes*

The following driveway finishes are permitted within the road reserve:

a) plain concrete;
b) coloured concrete;

c) stencilled and stamped concrete;
d) exposed aggregate to specifications; and
e) Asphaltic Concrete.

If any finishes other than plain concrete are used, the owner acknowledges that the City is only required to replace the driveway in plain concrete if any City assets are to be completed, impacting the driveway.

Ceramic or quarry tile finishes are not permitted, as tiled surfaces can become slippery and a public safety risk.

The City will not accept pavers within the road reserve.

If a driveway surface finish other than the above is proposed, the City will consider the application individually based on merit.

Details of the proposed driveway surface finish are included in the driveway application submission.

2.13.3.5 *conditions for driveway works other than plain concrete*

The City recognises the increasing desire for residents to create a less harsh, more natural, or "attractive" appearance in constructing footpath crossings. To achieve this aim, the City can accept coloured concrete and patterned or moulded concrete finishes in the footpath crossing subject to the following conditions:

a) Coloured concrete to be restricted to a range of colours that blend in with and do not conflict with the existing street scene;
b) are only approved in streets that are fully serviced and in which the need to provide additional underground services within a reasonable time is not evident; and
c) the relevant City department approves of the particular surface finish of its potential to be a slip, trip or fall hazard.

Note: City works to modify or replace a driveway in the future due to City infrastructure/utility works will be in plain concrete as standard procedure and may or may not match the existing surface finish.

2.13.3.6 *Unauthorised driveways*

If driveway works are completed without prior City approval, action can/will be taken against the owner, including but not limited to fines, cost recovery and/or issue of Orders for the illegal works to be removed.

If an unauthorised driveway is found and considered to be of a reasonable standard, a letter will be sent to the owner and/or Contractor requesting an explanation as to why no prior approval was sought and why it should not be removed. If the answer is satisfactory, the proponent must:

a) Pay all outstanding fees; and
b) Provide a statutory declaration declaring the works were constructed in accordance with the City's standards.

Upon receipt, the City will issue a letter confirming that it is now approved.

Note: The City will not accept unauthorised works that are a public safety hazard or are largely non-compliant with the City's specifications until necessary rectifications are completed.

2.13.3.7 *Scraping driveway*

The City's driveway specifications are compiled in reference to the standard vehicle defined by Australian Standard AS2890.1. They are designed to permit access to most models of vehicles at

present on the market and to most existing road profiles without scraping. These specifications, however, do not provide for any modifications such as tow bars, body kits, lowering of exhaust systems or suspensions, special/unique sport vehicles, heavily laden vehicles or vehicles travelling at excess speed or nonstandard road profiles.

The City is under no obligation to amend a road profile so that a vehicle including a standard B99 or B85 vehicle as defined in AS2890.1 can access a property either via an existing or proposed driveway access.

If an applicant wishes to install a new driveway or modify an existing driveway, the Applicant will bear all costs including any associated fees.

2.13.3.8 *Service authorities and new subdivisions or developments*

The owner cannot construct a concrete driveway across the verge if underground services are not provided in a new development area. If a formwork inspection is requested, the formwork cannot be approved. Where a service authority damages an existing driveway and is responsible for its repair, the service authority must undertake the works in accordance with this manual.

2.13.4 Second driveway access applications

2.13.4.1 *The City's position on a second driveway access*

The City will only permit one access point from a public road frontage (secondary roads where available) – refer to Coffs Harbour DCP Part F, section 1.2 (7)

The objectives for this control are as follows:

- To minimise traffic hazards to pedestrians and vehicles;
- To maintain on-street parking capacity;
- To allow flexibility in locating drainage pits, especially gully pits at low points, and outlets for roof water lines are maintained;
- To maintain gutter stormwater flow capacity;
- To ensure the cumulative effect of increased impervious areas and associated water runoff does not impact the stormwater drainage system;
- To maintain flexibility in locating public utility structures and street furniture, such as electricity poles, Telstra's pillars, bus stops, etc;
- To minimise footpath restoration costs of road authorities, which must be borne by the community as a whole;
- To maintain the aesthetic of the residential streetscape, which is not to be made less pleasing due to the increased paved surfaces within the footpath area; and
- The City's policy is in keeping with Transport for New South Wales policy 'Guide to Traffic Generating Developments' with site consolidation.

2.13.4.2 *Details required with second driveway access applications*

Under exceptional circumstances, consideration may be given to the provision of second driveway access. In such cases, the owner must apply to the City in writing, as follows:

a) letter requesting permission for second driveway access; this letter must determine the reasons for the necessity of the second driveway access; and
b) information specified in Section 2.3.3 and additionally, information to address the objectives specified in Section 4.1 (above).

If the second driveway access forms part of further development within the property, i.e., a garage, carport etc., then the City will not accept the second access application unless it forms part of an overall Development Application for these structures.

Second driveway access is not automatically permissible or approved for new development by virtue of its existing development on the site. All new development shall be considered on merit, which may require the removal of an existing secondary driveway.

2.13.5 General

These specifications apply to all parties when constructing a driveway:

A. vehicular access;

B. concrete footpaths; and

C. concrete kerb and gutter.

2.13.5.1 *Costs*

The Applicant is responsible for public safety and all associated costs. These include traffic management, excavation, laying of concrete, backfilling, turfing, alterations to existing structures (e.g., fences, gates, driveways, and footpaths), roof water drainage, road reserve rehabilitation or any other works which may be specified or required. The City shall require the driveway application fee to cover assessment and inspections by the City. If reinspections are required, additional fees may be imposed.

2.13.5.2 *Materials*

Refer also to Section 3.4 of this document.

The use of flexible pipes must be compliant with AS/NZS 2566.1, installed in accordance with the manufacturer's requirements and the City's Construction Development Specifications. A minimum cover of 450mm is required. This may be reduced if under a complying concrete driveway.

2.13.5.3 *Trees*

No trees are to be cut down, pruned, or relocated without the written consent of the City.

2.13.5.4 *Public liability insurance*

All nominated contractors/applicants must carry public liability insurance with a minimum cover of twenty million dollars ($20,000,000) and submit to the City a minimum of 3 days before commencing work. The contractor/proponent is responsible for ensuring that insurances are current.

2.13.5.5 *Provision for traffic*

All pedestrian and traffic control management must comply with AS 1742.3 Traffic Control for Works on Roads and parking for vehicles.

Safe and convenient passage for pedestrians' and vehicles shall be always maintained. Including adequate illumination of these signs and barriers at night and any required warning lights on barriers.

No plant equipment or excavated material shall be deposited on any footpath or roadway to obstruct pedestrian or vehicular traffic or any road or footpath drainage. All footpaths shall be trimmed, and materials and plant shall be kept within the narrowest practical limits and, if directed by the City, within a hoarding area without prior approval from the City.

Should the proponent fail to carry out any provision of this section of the specification, the City may carry out the work and invoice the Contractor for works completed after notice in writing.

2.13.5.6 *Design and setting out*

The proponent is responsible for setting out the driveway to comply with the approved design and relevant City specifications. Any anomalies encountered during construction should be reported to the City for evaluation before the pre-pour inspection request.

The proponent must have a copy of the approved plans and driveway approval letter issued by the City available on-site at all times.

2.13.5.7 *Alterations and damage to mains, services and drainage structures*

Before commencing work, the proponent shall contact "Before You Dig Australia" on 1100 to obtain existing services. The Contractor's responsibility is to confirm the locations and depths of all public services and house services before the commencement of work. The proponent shall be responsible for any damage to public utilities, private services or drainage structures resulting from their operations.

Where alterations to any public utility or private service are necessary, the proponent shall notify the City and arrange with the service authority concerned to make such alterations as expeditiously as possible.

Where it is necessary to alter any of the City's assets, such alterations shall be carried out as directed by the City at no cost to the City. Depending on the works and engineering design scope, these alterations may entail a separate application, approval and fee process, and potential payment of bonds to the City.

The proponent shall bear the cost of any alterations necessary to ensure compliance.

2.13.5.8 *Inspections*

At least two working days' notice must be given to the City for inspections.

Hours of inspection: 0800-1500, Monday to Friday.

Concrete inspection stages

a) Formwork – when the site is excavated with formwork and reinforcement in place, ready to pour concrete; and
b) Final – When all work is complete, the site will be cleaned, and the road reserve will be rehabilitated to a level acceptable to the City.

Road pavement

As per the City's suite of Standard Drawings, at each road pavement construction stage.

2.13.5.9 *Safety of works*

The proponent must ensure that all stages of the work are carried out under the specifications, regulations and applicable laws in a safe manner and left in a safe state. The Contractor's responsibility is to provide signposting, barricades, safe pedestrian thoroughfare lights and other necessary safety measures. All safety equipment (including lights) must be in good working order. Prices are to include all measures for traffic control and pedestrian safety.

The contractor shall fulfil the Work Health and Safety Act 2011 (the WHS Act) to ensure that the land, buildings, plant, or substances are safe and without health risks. The WHS Act imposes a duty upon persons who have, to any extent, control of non-domestic premises used as a place of work. For example, the duty is of work or as a means of access thereto or egresses therefrom or as a place where they may use plants or substances provided for their operation at work.

The City is not responsible for 'on-site safety and security, including the security of the Contractor's equipment. The Contractor should be aware of the potential vandalism of safety equipment and should take appropriate measures. The City will not accept the use of damaged or broken safety equipment on-site, and the Contractor must ensure any damaged safety equipment is immediately replaced.

All claims for damages allegedly arising because the works were carried out in an unsafe manner or left in an unsafe state to endanger the Contractor, sub-contractor and their employees, or the public shall be the Contractor's sole responsibility. The Contractor can be required to instil in their employees an awareness of safety and to supervise employees' actions to ensure such safety. Attention is drawn to the Contractor's responsibilities under the WHS Act.

2.13.5.10 *Environmental requirements*

The City is committed to local environmental protection and providing safe conditions for residents. The Contractor is required by legislation to ensure there is no environmental damage and that the health and safety of all persons and properties are maintained.

Under Section 120 of the *Protection of the Environment Operations Act 1997* ("the POEO Act"), it is an offence for any person to pollute waters. A pollution incident is defined within this legislation as "an incident or set of circumstances during or as a consequence of which there is or is likely to be a leak, spill, or other escape or deposit of a substance as a result of which pollution has occurred, is occurring or is likely to occur".

This means an actual pollution incident does not have to have occurred for an offence to be committed. However, the fact that no controls are in place to prevent an incident from occurring is classed as an offence under the act. Water pollution also encompasses the stormwater drainage system and natural waterways.

The person is responsible for carrying out the work to ensure that controls are in place before a job is commenced to prevent a pollution incident.

The Contractor is responsible for making any sub-contractors aware of the environmental requirements before any work is undertaken, and all works comply with the Blue Book (elaborate what the Blue Book is).

Therefore, erosion and sediment controls must be put in place before work commences, and the controls must be in place during the work. Any potential contaminants that could cause pollution to enter a waterway once the job has been completed must be cleaned up.

This should include but is not limited to:

- Putting in place on-site (e.g., sediment control fencing) and offsite (e.g., sediment control socks around stormwater inlets) controls to prevent spillage and pollutants from entering drains or waterways;
- Ensuring workplaces are maintained in a condition to provide a safe environment for pedestrians, workers and passing vehicles;
- Put in place controls to prevent sand, sediment, topsoil, and the like from being washed, carried, or blown from construction and work sites;
- Ensuring supervisors and workers on the site are aware of the environmental protection and safety requirements; and
- Having adequate pollution control and spill clean-up resources available at each worksite and ensuring that all workers know what to do if a pollution incident occurs.

Penalty Infringement Notices (PIN) and clean-up notices are used where breaches are considered minor. The Protection of the Environment Operations (General) Regulation 2009 details the penalty fees applicable to each offence under the POEO Act.

Where an incident has been considered a significant pollution incident, there is the potential for prosecution and maximum penalties for corporations and individuals described in the relevant sections of the POEO Act.

2.13.5.11 *Repair of work following wet weather*

The contractor shall ensure that all necessary measures are provided at all times to protect the works from the effects of rain to the satisfaction of the City. The proponent is responsible for repairing all storm damage. The City will provide the proponent with notice of any requirements for repair work. Repair works must be carried out at no cost to the City, using approved methods in accordance with the Blue Book, and must be commenced within 24 hours of receiving notice to repair works.

2.13.6 Construction requirements

2.13.6.1 *Description*

The work shall be constructed in-situ to comply with the relevant standard drawings, aligned in straight lines as shown or as may be directed, and accurate to the drawing's grades and without local irregularities.

2.13.6.2 *Subgrade*

All soft, yielding, and other unsuitable material shall be removed, and the subgrade shall be thoroughly compacted and finished to a firm, smooth surface, or uniform bearing value.

All concrete driveways and footpaths should be poured onto a 50mm thick sand or metal dust base, spread to an even thickness, thoroughly soaked with water, and well compacted before pouring concrete. All laybacks, kerbs, gutters, and dish drains shall be poured onto a 100mm thick layer of compacted DGB (expand) or approved equivalent.

2.13.6.3 *Formwork*

Formwork shall be built true to line and braced substantially and unyieldingly. It shall be mortar-tight, and the interior surfaces shall be adequately oiled, greased or soaped to ensure non-adhesion of the concrete. The material used for exposed surfaces shall be sized softwood timber dressed on one side and both edges. Undressed timber may be used for backing to unexposed surfaces. Formwork must be provided at all vertical faces.

2.13.6.4 *Ready-mixed concrete*

The minimum concrete compressive strength (f'c) at 28 days shall be 32MPa for driveways, footpaths, laybacks, kerbs, gutters, and dish drains.

2.13.6.5 *Placing concrete*

Care shall be taken to fill every part of the formwork by continuous tamping, spading, or slicing, and working the coarsest aggregate back from the exposed surfaces. Exposed concrete surfaces shall be struck off, broom finished, and corners and edges drawn shall be left neatly rounded. Concrete shall not be disturbed after it has been in the formwork for 10 minutes.

2.13.6.6 *Thickness of concrete*

Unless shown otherwise on the attached standard plans, the thickness of the concrete shall be in accordance with the City Standard Drawing 200 series.

2.13.6.7 *Reinforcement*

All reinforcement shall be free from rust, grease, tar, paint oil, mud, mill scale, mortar, or any other coating, stored under a waterproof shelter, and supported above the ground's surface. The

reinforcement shall be secured against displacement due to the concrete's flow and working when in position.

2.13.6.8 *Expansion joints*

All expansion joints shall be perpendicular and filled with a strip of bitumen-impregnated board or closed cell foam 10 millimetres thick, extending entirely through the slab. Where the kerb and gutter are cast in position, expansion joints shall be provided at intervals of not more than 4 metres. The provision of expansion joints shall be in accordance with the City standard drawings 200 series.

Where a vehicular driveway will be provided, an expansion joint shall be placed at the back of the gutter driveway. A vehicular driveway connects to an existing concrete driveway inside the property; an expansion joint shall be placed at the boundary alignment.

All false joints on the vehicular driveway and footpath slabs shall be made to form a straight, well-defined line using an appropriate jointing tool.

2.13.6.9 *Kerb and gutter*

The integral kerb and gutter shall be constructed in situ to the dimensions shown on the City's Standard Drawing. The kerb alignment must be straight lines and circular curves marked on the ground or directed, valid to grade without irregularities.

In areas where the adjacent existing kerb and gutter have dimensions different to the City's standards, the new kerb and gutter shall be constructed to match the existing subject to prior approval.

2.13.6.10 *Finish*

After removing formwork, any rough or porous places or holes shall be picked up and dressed with a 2:1 cement mortar or approved cementitious repair product. The exposed surface shall be broom finished with bull-nosed edges to leave the surface plain, smooth, and uniform in colour and appearance. All kerb, gutters and laybacks shall be finished with a steel float to leave the surface plain, smooth and uniform in appearance and must be in plain concrete.

Upon final inspection by the City, if it is found that the surface finish is slippery and is considered a public safety hazard, the works cannot be approved. Additional surface treatments are required at the Applicant's cost to the satisfaction of the City.

2.13.6.11 *Curing and protection*

After completion of concreting for any section, that section shall be covered with wet bags or canvas and kept moist for three days or longer if directed to prevent rapid drying out of the concrete. The work is to be protected from damage for the same period.

2.13.6.12 *Refilling*

After the concrete has set sufficiently, and not sooner than three days after placing, spaces around the sides of the work shall be refilled with sound material, which shall be thoroughly compacted in layers no greater than 150mm, with all potential trip hazards removed.

2.13.6.13 *Regrading and returfing*

Regrading and returfing shall be undertaken on either side of the concrete work, with a maximum slope of 1:6 (vertical):(horizontal). All disturbed footpath areas shall be returfed with a grass type to match that existing and shall be free of weeds when laying. The verge area is to be left in good condition.

2.13.6.14 *Excess spoil*

Excess spoil shall be removed from the job. Where excavated material is to leave the site, it must be disposed of at an approved landfill facility.

Note: The exportation of fill or soil from the site must be under the provisions of the Protection of the Environment Operations Act (POEO) 1997 and the Office of Environment and Heritage "Waste Classification Guidelines" and shall comply with the terms of any approval issued by the City.

2.13.6.15 *Difference in levels*

There is a difference in levels between those existing at fence alignment and designed levels; suitable adjustments within the owner's property will be necessary. This situation will be noted on the plan and subject to negotiation between the Contractor and the owner. It is suggested that greater ease of access will be obtained if sharp grade changes are avoided.

2.13.6.16 *Road shoulder*

If directed by the the City, the existing road shoulder shall be regraded, reshaped and trimmed as necessary to allow for the proper control and free flow of drainage.

2.13.6.17 *Road pavement*

All road pavement restorations shall be completed under the City's specifications.

2.14 APPENDIX B – Information to be shown on drawings – Road design

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
1.	**General**			
a)	Cover sheet with locality plan, list of drawings and their revision number			
b)	A list of all relevant standard drawings required to build the works			
c)	Plans prepared in A1 or A3 format, drawn at an appropriate scale to provide sufficient detail			
d)	Drawing scale is shown on drawings as a bar scale on each sheet.			
e)	Scale of detail drawings is shown as appropriate at 1:100, 200, 250, 500, 1000, 2000			
f)	Schedule of symbols			
g)	Benchmark within 100 metres of development site is shown			
h)	North point shown			
i)	Site topography is shown via contour lines			
j)	Datum reference including benchmark at AHD adopted by NSW Department of Lands			
k)	Each plan to be numbered with revision no. and revision schedule and revision date, with a cloud around revisions with a revision no.			
l)	Road names or number			
m)	Drawings to be signed by respective consultant / engineer			
n)	Lettering, line work and symbols to conform to AS 1100			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
o)	Details of any 'future works' designed to enable detailing of proposed works, stage boundaries and limit of work			
2.	**Road layout plans**			
a)	Existing services and structures are shown			
b)	Lot boundaries and numbers shown			
c)	Road hierarchy, classification and formation width for each road is shown			
d)	Road centreline chainages, radii, tangent points superelevation critical points and deflection angles shown			
e)	All turning movements have been checked for swept path compliance with design and checking vehicles.			
f)	Critical vehicle movements are shown on separate plans, including turning at intersections and cul-de-sacs			
g)	Road reserve widths indicated			
h)	Road formation widths indicated			
i)	Road carriageway widths indicated			
j)	Proposed utilities locations and offsets are shown and tabulated (typical section only)			
k)	Utilities crossings shown			
l)	Vehicular access crossings are clearly shown, are at appropriate locations and details are clearly documented.			
m)	Kerb or open channel drain profiles are clearly nominated			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
n)	Radii on kerb returns and kerb lines shown			
o)	Internal intersections to the development are shown in sufficient detail to support proposed design, including proposed kerb radii			
p)	External intersections to the development are shown in sufficient detail to support proposed design, including proposed kerb radii			
q)	Footpaths are located on plan at correct offset and dimensions and details are indicated (typical section only)			
r)	Shared paths are clearly shown and dimensions and details are indicated (typical section only)			
s)	Location of signage, safety barriers and line marking is shown			
t)	Topographic contours and intervals are clearly shown			
u)	Cut and fill batters shown			
3.	**Road longitudinal sections**			
a)	Longitudinal sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
b)	Centreline long section shows the following at no more than 20 metre intervals and at all intermediate changes of grade;			
i)	Chainages			
ii)	RL of existing surface			
iii)	Design RL of new road			
iv)	Design grades			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
v)	Length of vertical curves and the curve K value			
4.	Kerb return long section shows the following at no more than 2 metre intervals and at all intermediate changes of grade			
i)	Chainages			
ii)	Design RL of kerb invert			
iii)	Design grades			
iv)	Length of vertical curves			
v)	All service crossings including a description, RL and depth			
5.	**Road cross sections**			
a)	Cross sections are drawn at scale of 1:100 natural			
b)	Cross sections show the following at no more than 20 metre intervals and at all intermediate changes of grade or profile;			
i)	Chainages			
ii)	RL of existing surface			
iii)	Design RL of new road			
iv)	Drainage infrastructure, with invert levels			
v)	Location of footpaths and Utilities			
vi)	Batter cut/fill gradients – cross section to extend to min 1.0m past batter toe			
vii)	Pavement cross-falls including any super-elevated curves			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
viii)	Pavement details including layer thicknesses and material types (typical section only)			
ix)	Wearing surface details (typical section only)			
x)	Details of sub-soil drainage (if required)			
xi)	Road reserve boundaries			
xii)	All cross sections must be extended until design levels coincide with natural ground levels or refence to a plan clearly indicating the extent of cut and fill.			
6.	**Miscellaneous**			
a)	Location and details of any estate entry structures			
b)	Location and details of and local area traffic management devices			
c)	Location of vegetation to be removed or retained			
d)	Location and details of any batter catch-drains			
e)	Landscaping details for roundabouts			
f)	Details of the type of vegetation to be used on batters			
g)	Details of any retaining structures to be used in batters or split-level carriageways.			

2.15 APPENDIX C – Checklists – Road design

Item No.	Description	Reference	Developer confirmation	City confirmation	Comments
1	Have all engineering design condition of the development consent been met, and required documentation submitted				
2	Traffic study including start-up parameters	2.5.3			
3	Details of estate entrance features	2.6.3			
4	Pavement design report	2.11.3			
5	Subgrade evaluation report	2.11.5			
6	Details of source and properties of pavement materials	2.12.1			
7	Asphalt mix designs	2.12.2.1			
8	Asphalt mix designs for roundabouts	2.12.2.4			
9	Primer seal design	2.12.2.1			
10	Bitumen seal design	2.12.2.2			
11	Details of material to be used in unsealed gravel pavement	2.12.2.3			
12	Safety in Design report	1.5.2			

PART 3

TECHNICAL GUIDELINE

FOR

STORMWATER

DRAINAGE AND WSUD

3 Technical guideline for stormwater drainage design and WSUD

3.1 Introduction and objectives

This document outlines the City's minimum requirements for stormwater drainage design and Water Sensitive Urban Design (WSUD) in developments or subdivisions.

The principal objective is to promote development within the City LGA whilst ensuring the following:

- The safe and efficient collection and control of all stormwater generated within the subdivision or development;
- The safe and efficient collection and control of all stormwater entering the subdivision or development from up slope catchments;
- Provision of an effective outlet for all collected stormwater from the subdivision or development to a natural watercourse;
- Achieving these objectives without detrimentally affecting the general environment, surface and subsurface water quality, groundwater infiltration characteristics and watercourses both upstream and downstream of the subdivision or development;
- Design and construction of a stormwater network that is both feasible to construct and economical to maintain in the long term;
- Design and construction of a stormwater network that does not place an unnecessary burden on the City's maintenance and operations resources;
- Promotes opportunities for Water Sensitive Urban Design (WSUD) principles; and
- Considers and allows for climate change in the design of the stormwater system.

The design of stormwater drainage systems shall be based on best practise engineering standards and shall meet or exceed the requirements of these Guidelines as well as relevant sections of any publications referenced herein.

This document is in no way a comprehensive design manual and is intended to be read in conjunction with and as a supplement to documents and publications referenced herein, in particular Australian Rainfall and Runoff 2019.

The design of Stormwater should be undertaken with consideration for the design of other services including those nominated in the sections listed below:

Part 1	General Requirements
Part 2	Technical Guideline for Design of Roads
Part 4	Technical Guideline for Design of Water Reticulation
Part 5	Technical Guideline for Design of Sewerage Reticulation
Part 6	Technical Guideline for Landscaping
Part 7	Technical Guideline for Bulk Earthworks and Retaining Walls

3.2 References

This Part should be read and utilised in combination with the following publications as referenced throughout:

- Australian Rainfall and Runoff 2019 (ARR 2019);
- Floodplain Risk Management Guide - Incorporating 2016 Australian Rainfall and Runoff in studies;
- AS 1100 – Technical Drawing;
- Australian Standard AS3500.3 – Stormwater Drainage;
- CSIRO Publication; 'Urban Stormwater Best Practice Environmental Management Guidelines';
- Queensland Urban Drainage Manual (QUDM) - Fourth Edition;
- Soils And Construction - Managing Urban Stormwater (The Blue Book);
- City of Coffs Harbour Construction Specifications; and
- City of Coffs Harbour suite of Standard Drawings

3.3 Definitions

For the purposes of stormwater drainage design, a built-up area is an area with average lot size equal to or less than 2,000m^2.

For the purposes of stormwater drainage design, a rural residential area is an area with average lot size greater than 2,000m^2 but less than 10ha.

For the purposes of stormwater drainage design, a rural area is an area which is predominantly undeveloped (<2% of area developed hardstand or structures) with average lot size greater than 10ha.

An engineer is a person with a qualification from an accredited program listed as acceptable for Membership of The Institution of Engineers Australia, a person who has been assessed as meeting the Stage 1 Competency Standard as assessed by Engineers Australia or a person with equivalent qualifications and experience and is deemed to be suitably experienced by the City.

3.4 Stormwater certificate application documents

3.4.1 Design drawings

Design drawings shall be submitted to the City for approval. Information to be included in the design drawings is detailed in APPENDIX A – Information to be Shown on Drawings.

3.4.2 Design checklists

Each of the supporting items or documents listed in the checklists in APPENDIX B – Checklists shall be completed and submitted with the Drawings. Should any of the items required in any checklist be outstanding or not to a standard acceptable to the City, the Drawings and checklists shall be returned to the Developer's Representative for amendment. The City shall only commence review of the design drawings once it is satisfied that all the requirements of the checklists have been met.

3.4.3 Stormwater servicing strategy

The stormwater strategy submitted with the application for development consent shall include the following as a minimum:

- Type of minor system proposed (overland/piped underground);
- Location of major system overland flow paths;
- Location of any trunk drainage systems;

- Catchment and sub-catchment boundaries including all upslope contributing catchments, areas, and land use types. The catchment and sub catchment areas shall be provided in a tabular form;
- Analysis of topography, including natural drainage paths and watercourses;
- Consideration of flows from upstream developments and catchments, and consideration of the impact of the development on downstream developments and catchments;
- Location and type of any drainage retention or detention structures;
- Simplified calculations to demonstrate & support detention capacities and adequacy of allocated spaces; and
- Location and type of any water quality devices.

The City must be immediately informed of any variations to the stormwater servicing strategy that are identified during the detailed design phase.

For staged developments the stormwater strategy for the full development is to be submitted with the Civil Works Certificate plans for each stage.

3.5 Stormwater drainage systems - general design criteria

Stormwater drainage design shall consider the entire catchment area, not just the area included within the subdivision or development. The Developer's Representatives shall base the calculated peak flow on the ultimate full potential development of the entire stormwater catchment containing both the development site and upstream area for normal flow situations as well as the overland flooding caused by pipe blockages, mainstream flooding and high water levels.

Prior to commencing the detailed design, the Developer's Representatives must determine the land zoning of the upstream catchment area contributing to the stormwater drainage system within the subdivision or development. Consultation with the City's planning and engineering staff is encouraged in this regard. Consideration and management of flows from all upstream developments and catchments into, and within the development, along with the management of flows through the development shall be detailed. Staged upgrading of drainage systems shall not be permitted.

3.5.1 Major / minor system design approach

The Developers Representative shall adopt the 'Minor/Major System' approach as outlined in Chapter 5 in Book 9 of ARR 2019 for the design of all stormwater drainage systems.

3.5.2 Design elements

Stormwater drainage infrastructure is generally composed of combinations of some or all the following design elements:

- Piped inter-allotment drainage;
- Underground minor system consisting of a network of pits and pipes, with kerb and gutter on roadways;
- Overland minor system comprising of table drains, swales and channels;
- Underground piped major system;
- Overland major system consisting of open drains and channels;
- Trunk drainage system;
- Drainage retention or detention structures; and

- Water quality devices.

The majority of developments within the City LGA will involve the design of stormwater drainage that falls within one of the Drainage Design Standard (DDS) categories as per Table 3-A, and the City will assign a DDS to each subdivision or development as a condition of development consent.

Table 3-A - Drainage design standard (DDS) matrix

Design Element	DDS 1	DDS 2	DDS 3
Kerb and gutter	✓	✓	×
Piped underground minor system	✓	✓	×
Overland minor system open channel (table drains)	×	×	✓
Piped underground major system	✓	×	×
Overland major system including roadways	×	✓	✓
Trunk drainage system;	**As required**	**As required**	**As required**
Drainage retention or detention structures	**As required**	**As required**	**As required**
Water quality devices	**As required**	**As required**	**As required**

Where a standard DDS as per Table 3-A is not appropriate for drainage within a particular subdivision or development, the City will determine the requirements for each design element of the drainage as a condition of development consent.

3.5.3 Piped minor drainage system

Where the minor system is designed to be underground, this typically consists of a pit, pipe and kerb and gutter network with sufficient capacity to capture flows from nominated storm events designed to an Annual Exceedance Probability (AEP) as shown in Section 3.5.6 and convey them to a natural watercourse. These pipelines prevent stormwater damage to properties and limit the frequency and quantity of surface water to a level that is acceptable to the community. Pipelines may or may not follow the natural drainage paths and are usually aligned along property boundaries and the roadway kerb and gutters.

3.5.4 Overland minor drainage systems

Where the minor system is designed to be overland, this typically consists of open channel drains designed parallel to roadways to convey flows generated by the Annual Exceedance Probability as prescribed in Section 3.5.6 to a natural watercourse. Where open channels intersect with roadways, culverts under the road shall be designed to connect to table drains or open channels. The major drainage system design will typically dictate the design of an open channel, refer to Section 3.5.5.

3.5.5 Major drainage systems

The major system caters for the runoff from storms of higher intensity than for which the minor drainage system has been designed and typically consists of overland flow paths designed to convey flows when the capacity of the minor system is exceeded. The major drainage system shall be designed to convey flow resulting from 1% AEP storm events to a natural watercourse.

Note that if the major system cannot safely contain the runoff from the design event, the minor system may be upsized to create a combined major/minor system with adequate capacity to convey flow resulting from 1% AEP storm events.

3.5.6 Design average recurrence intervals

For all drainage systems the following Annual Exceedance Probabilities (AEP) shall be adopted:

3.5.6.1 *Design recurrence intervals*

Table 3-B – Design recurrence intervals

Location	Design storm AEP
Residential areas - minor system	20%
Inter-allotment drainage - minor system	Same as minor system for the location
Rural areas - minor system	20%
Commercial areas - minor system	10%
Industrial areas - minor system	10%
Transverse drainage culvert or bridge under a minor road (Class 4 or 5 road)*	10%
Transverse drainage culvert or bridge under a minor road (collector road) *	5%
Transverse drainage culvert or bridge under a major road (sub-arterial or arterial)	1%
Major systems	1%

* For Class 4 or 5 and collector roads where no alternate route is readily available, an increase in cross drainage design event probability to 2% AEP may be required by the City.

3.5.6.2 *Major system recurrence interval*

The Developer's Representative shall ensure that peak 1% AEP flows have a safe and effective flow path to a natural watercourse or to an established trunk drainage system when the capacity of the minor system is exceeded. Overland flow paths must be clearly shown on the detailed design drawings. The major system design may necessitate design of increased capacity in the minor system so that the combined systems can convey major flows safely.

State significant and emergency services infrastructure may have a higher major system recurrence interval than 1% AEP. The determination of the recurrence interval for these developments will be project specific and may be based on the guidance provided in Table 7.3.2 of QUDM.

3.6 Hydrology

3.6.1 Times of concentration

Typical applications of the methods used to calculate times of concentration (t_c) are tabulated in

Table 3-C. Where proposed developments consist of a combination of urban and rural sub-catchments, it will be necessary to determine the t_c for each sub-catchment separately.

Table 3-C Time of concentration calculation methods

Example Application	Calculation Method	Reference
Sheet flow generally from lots to road gutter. Typically flow distances up to 50m.	Kinematic wave equation	3.6.1.1 of the Guidelines
Roof catchment to road gutter	Recommended roof drainage system times	Section 4.6.5 of QUDM
Urban time from lot to drainage system	Kinematic wave equation + concentrated kerb flow travel time	3.6.1.1 & 3.6.1.2 of the Guidelines

3.6.1.1 *Kinematic wave equation*

Times of concentration for each sub-catchment in a built-up area shall be determined using the kinematic wave equation, as detailed in Section 4.6.6 of QUDM

$$t_c = \frac{6.94(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.3}}$$

where t_c is the overland flow time (minutes);

L is the flow path length (metres);

n^* is a surface roughness or retardance co-efficient;

I is the rain intensity (mm/hour); and

S is the slope (m/m).

The kinematic wave equation is only applicable to gradually varying flows where back water effects are negligible. The kinematic wave equations should not be applied once flow is concentrated or for flow paths beyond 50m. Additional travel time should be calculated using 3.6.1.2.

The kinematic wave equation is very sensitive to slope and the Retardance Co-efficient (n*) and these should be estimated carefully. Where appropriate and approved by the City, the retardance co-efficient range specified in Table 4.6.5 of QUDM may be adopted. Otherwise, recommended Retardance Coefficients are listed in Table 3-D.

Table 3-D - Retardance coefficients

Land Use	Retardance co-efficient (n*)
Road/paved areas only	0.01
Normal residential	0.08
Rural residential	0.08
Medium density residential	0.06

Industrial/commercial	0.04
Parkland	0.15
Open space (natural bushland)	0.3

Where t_c is in excess of 14 minutes, it will be necessary to validate the use of such a t_c in the calculations.

3.6.1.2 *Concentrated kerb flow travel time*

Concentrated flow times including kerb & gutter flows shall be calculated using Manning's equation (Figure 4.6 of QUDM) or Izzard's equation (Figure 4.7 of QUDM).

3.6.2 Methodology for determining pre-developed peak flows

Peak flow estimation for each pre-developed area shall be determined using an appropriate hydrological model. Models should use losses as per the guidance in ARR2019 and the NSW specific guidance 'Floodplain Risk Management Guide - Incorporating 2016 Australian Rainfall and Runoff in Studies'.

3.6.3 Methodology for determining post-developed peak flows

Stormwater drainage design shall include a stormwater catchment plan showing the total catchment area and sub areas that form the basis of the design including all contributing upslope catchment areas, together with stormwater drainage calculation sheets or summaries of computer modelling. Additional catchment plans are required if the major system catchments do not align with the minor system catchments.

Partial areas shall be considered when determining peak flow for sub catchments, particularly in instances where the catchment contains sub areas, such as reserves, that may have a relatively large time of concentration in conjunction with a small co-efficient of runoff. In some instances, a partial area design discharge may result in runoff that is less than (or the same as) a discharge that has been calculated at some upstream point. A check of the partial area flows shall be required to determine the peak flow. The peak flow to be adopted for design purposes shall be the largest flow from either full or partial area calculations.

It is the responsibility of the Developer's Representative to determine the most appropriate methodology for each application. Various drainage tools, proprietary software and construction methods are available to the Developer's Representative to achieve an appropriate design. Regardless of the technique or method used, detailed documentation shall be submitted for approval.

ARR2019 temporal pattern ensembles shall be used when determining the design peak flow. The design event shall be considered the event generating the 'flow higher than the mean peak flow' for the critical duration.

Where computer software is used for hydrological modelling, it shall be a 'recognised industry standard' software program. A comprehensive list of set-up parameters and details of the loss model used to obtain results from the software is to be submitted along with the detailed input and output documentation.

For catchment areas greater than 50 hectares, two recognised runoff estimation methods shall be used to enable comparison or runoff estimates.

The City has access to the Watercom DRAINS software package. The City prefers stormwater calculations to be submitted as a DRAINS file. Any other industry recognised software may be used

but details of all 'nodes' and 'links' must be provided in the format shown in Appendix D so that if desired, the City can create a verification model to assess the design. Assessments requiring a verification model may extend the time taken to review the design.

For catchments where a City endorsed flood study exists, the applicable runoff routing model, and calibrated parameters may be used.

3.6.3.1 *Design rainfall intensities*

Rainfall intensities adopted for design with a time of concentration of less than 30 minutes are to be those issued by the Bureau of Meteorology on the ARR data hub. IFD values shall be obtained using the site specific latitude and longitudes.

For development sites with a time of concentration of 30 minutes or more, the IFD data from the local Coffs IFD datahub should be compared to the BoM IFD, the higher of the two IFD values shall be adopted.

Coffs IFD Datahub - https://coffs-data.arr-software.org/

ARR2019 specifies how climate change is to be applied to calculate design rainfall intensities formula 1.6.1 from ARR Book 1 shown below.

$$I_p = I_{ARR} \times 1.05^{T_m}$$

where I_{ARR} is the design rainfall intensity (or depth) for current climate conditions

T_m is the change in mean temperature and

I_p projected rainfall intensity (or depth)

The NSW government's projection for the North Coast is 1.9ºC increase in mean annual temperature by 2070 as prescribed from the Adapt NSW website. 1.9ºC increase in mean annual temperature relates to 10% increase in rainfall intensity as calculated using formula 1.6.1 from ARR Book 1.

Based on the ARR data hub data using RCP 8.5 the projected increase in mean annual temperature is 3.7 ºC to 2090 (this is the longest projection available). This relates to an increase in rainfall intensity of 20%. Table 3-E includes the rainfall multipliers to be applied to the BOM IFD data for various elements of the design.

Table 3-E – Climate change rainfall multipliers

Modelling purpose	Projection year	Rainfall multiplier
Pit and pipe network	2070	1.10
Major system (1% AEP)	2070	1.10
Major system freeboard check	2090	1.20
Detention structures (required due to additional hardstand and efficient drainage systems)	Present day	1.00

The climate change projection to year 2070 has been adopted for most stormwater design types. This value has been selected to represent approximately half of the asset's 100 year design life. Projection to 2090 has been adopted for freeboard checking of major drainage infrastructure to test sensitivity of these systems where upgrades in the future are often difficult or impossible.

3.6.3.2 *Fractions impervious*

Typical fraction impervious values for ultimate catchment conditions are generally based on Table 4.5.1 of QUDM and shall be adopted as shown in Table 3-F.

Table 3-F - Fraction impervious

Land Use	f	Typical permissible lot size m^2
High rise residential	0.9	N/A
Residential lot in urban area	0.85	400 - 600
Residential lot in urban area including half road	0.80	400 - 600
Residential lot in urban area	0.75	600 – 1000
Residential lot in urban area including half road	0.70	600 - 1000
Residential lot in rural area	0.45 0.30 0.15	2000 5000 10000
Residential lot in rural area including half road	0.50	NA
Half width road reserve in urban area	0.80	NA
Commercial areas	0.90	NA
Industrial areas	0.90	NA
Public recreation areas and parks	0.10	NA
Open space (natural bushland)	0.00	NA

3.6.3.3 *ILSAX parameters*

Where ILSAX models are used to calculate developed flows the parameters shown in Table 3-G shall be used.

Table 3-G ILSAX parameters

Parameter	Value
Depression storage – impervious	2mm
Depression storage – supplementary	2mm
Depression storage – grassed	8mm
Soil type - clay	3
Soil type - sand	2
Soil type – grades > 15% (any soil type)	4
Antecedent moisture condition (AMC)	4

3.7 Design of piped drainage systems

Catchment areas to each pit shall be determined from contour information and proposed property boundaries. A site inspection should always be made to verify the contour information and assess the likelihood of any flow path deviations which may occur as a consequence of existing or proposed developments. Changes to flow paths can occur as a result of the construction of fences, earth bunds, retaining walls, buildings etcetera after the construction phase of the subdivision. The impact of these changes shall be considered at the design stage.

3.7.1 Design of pit inlets

3.7.1.1 *Pit locations*

The following criteria govern the location of pits in roadways for the minor system design:

a) Inlet pits are to be spaced so that gutter flow width does not exceed 2.5m;

b) Gutter flows should at no point overtop the kerb;

c) Bypass from any pit on grade is not to exceed 15% of the total flow at the pit (full capture is desirable);

d) Maximum spacing between pits shall not exceed the values in specified in Table 3-H

Table 3-H Maximum spacing of inlet pits

Condition	Pipe size	Maximum spacing (m)
Generally	Less than 1200mm	100m
	1200mm and above	150m
Immediately upstream of an outlet to a tidal waterway	any	100m

e) Maximum flows in gutters:

   a. Around kerb returns to be less than 0.02m^3/s and 1m in width;

   b. At designated on-street parking a depth multiplied by average velocity of 0.4m^2/s and 2m flow width;

   c. At kerb ramps and pedestrian crossings 1.0m in a 2% AEP event; and

   d. Adjacent to a bus stop 0.75m.

f) Inlets are not to be located on kerb returns between tangent points;

g) The location of inlet pits shall not be placed on small radius curves;

h) Inlet pits are not to be placed in line with the normal passage of pedestrians including kerb ramps; and

i) Curved lintel inlets will not be supported by the City. Pits involving lintels must be located outside the turning points.

Concentrated flow times for kerb & gutter and road flows shall be calculated using Manning's equation (Figure 4.6 of QUDM) or Izzard's equation (Figure 4.7 of QUDM).

3.7.1.2 *Inlet design*

Pit inlet capacities shall be determined in accordance with HEC-22. All new inlet pits shall be constructed using welded steel "Weldlok" type or equivalent grates with appropriate skirts.

Appropriate blocking factors shall be applied to inlet relationships.

3.7.1.3 *Blockage factors*

The blockage factors shown in Table 3-I are to be deducted from theoretical pit inlet capacities for inlet pit design.

Table 3-I Blockage factors for inlet pits

Inlet type	Blockage factor
Sag – kerb inlet (side entry)	20%
Sag – grated	50%
Sag – combination	Kerb inlet – 0% & Grate – 100%
On grade – kerb inlet (side entry)	20%
On grade – grated	50%
On grade – combination	10% (of total capacity)

3.7.2 Drainage pit design

3.7.2.1 *General*

- Standard pits in accordance with the City Standard Drawings 300 series or approved equivalent precast pits shall be provided in drainage lines at all changes in grade, level or direction and at all pipe junctions;
- A 150mm freeboard shall be allowed for between the peak water level for design events and surface levels at inlets.
- Pipe junctions where the deflection angle of the major flow is 90º or greater should be avoided;
- The vertical drop across pits shall be designed on the following basis;
    - Where there is no change in direction or pipe diameter; 30mm invert to invert;
    - Where there is no change in pipe diameter but direction change; 50mm invert to invert;
- Changes in diameter should be graded obvert to obvert;
- Where the depth of the pit exceeds 1200mm, step irons shall be provided at 300mm centres in accordance with AS 1657;
- The maximum depth of a pit shall be 4500mm unless agreed otherwise with the City;
- The design should maintain flow velocities through pits through the provision of benching to reduce pit losses;
- Drops invert to invert greater than 2.5 times the pipe diameter will not be permitted; and
- The internal dimensions of the drainage pit shall be based on accommodating the size of the stormwater pipe, with a minimum pit size for safe access based on the following:
    - 0m to 2m depth: 900mm x 900mm
    - 2.0m to 3.0m depth: 1200mm x 1200mm
    - 3.0m to 4.5m depth: 1500 x 1500mm

3.7.2.2 *Inlet pits*

Inlet pits are to be designed in accordance with the City Standard Drawing 300 series inclusive.

3.7.2.3 *Angle pits and junction pits*

Angle and junction pits are to be in accordance with the City Standard Drawing 300 series.

3.7.2.4 *Footway and field surface inlet pits*

Where footway or field surface inlet pits are required, they are to be in accordance with the City Standard Drawing 300 series.

3.7.2.5 *Surcharge pits*

Surcharge pits must have a minimum 225mm low level outlet to allow the system to freely drain. The calculated Hydraulic Grade Line at surcharge pits must include:

- Tailwater levels;
- Expansion loss;
- Change of direction; and
- Grate losses.

3.7.2.6 *Energy losses*

Energy losses should be calculated using the following formula in accordance with Chapter 5.5.3 of Book 9 of ARR 2019.

$$h_L = \frac{k \times {V_0}^2}{2g}$$

where;

h_L is the loss (m);

k is a dimensionless energy loss coefficient;

V_0 is the velocity of flow in the outlet or downstream pipe (m/s); and

g is the acceleration due to gravity (m/s^2).

Energy loss coefficients shall be iterated until the values converge.

3.7.2.7 *Minimum pit lengths*

Table 3-J specifies the minimum length of stormwater pits in the direction of flow based on the upstream pipe diameter (Du) and the vertical drop through the pit.

Table 3-J Minimum pit lengths

Drop through pit	Upstream pipe diameter (Du) < 600mm Min pit length (in direction of flow)	Upstream pipe diameter (Du) ≥ 600mm Min pit length (in direction of flow)
Drop ≤ 0.5 Du	1.0 Du	1.5 Du
0.5 Du < Drop ≤ 1.5 Du	1.5 Du	2.0 Du
1.5 Du < Drop ≤ 2.5 Du	2.0 Du	2.0 Du

Where Du is the diameter of the upstream pipe.

3.7.3 Pipeline design

3.7.3.1 *General*

The following points detail the minimum requirements for pipeline design:

a) All pipelines constructed shall be rubber ring jointed type;

b) Pipelines in roadways shall have a minimum diameter of 375mm in urban areas and 450mm in rural areas;

c) Pipelines may cross roads either perpendicular or skewed to the road centreline;

d) The skew angle of the pipeline where it enters the upstream wall of a pit shall be a minimum of 45 degrees and the pipeline shall be designed for the appropriate pit loss co-efficient. See City standard drawings 300 series for more detail;

e) Pipelines should have adequate inspection manholes spaced no greater than 100m for each drainage pipeline. Where the pipeline diameter exceeds 1200mm, this distance may be increased to 150 metres;

f) For single cell pipe systems, a downstream pipe of smaller diameter than the upstream pipe will not be permitted;

g) The inlet and outlet channels to pipelines should be carefully designed so as to avoid either scouring or silting velocities during storm flows, and adequate scour protection is to be provided at the outlet of all stormwater lines. Details of proposed scour protection to pipe outlets shall be shown on the design drawings;

h) All pipe inlets and outlets shall be designed with appropriate inlet/outlet structures;

i) Curved pipelines will not be permitted where the diameter of the pipeline is less than 900mm. Where curved pipelines are permitted and have prior approval by the City, they are to be constructed using rubber ring jointed reinforced concrete pipes and installed strictly in accordance with the manufacturer's recommended radii;

j) Whenever possible, pipelines shall be designed under and parallel to the road kerb and gutter. Additional pits will be required to negotiate curved alignments. The maximum distance from the pipeline centreline to the radius of the kerb and gutter face shall be 1.5m;

k) Pipes must be terminated at a pit or headwall. In staged construction pipes may also be terminated at the location of a future pit;

l) The need to access confined spaces especially in multi cell pipelines shall be minimised; and

m) The minimum and maximum flow velocity and pipe grades shall comply with the following to encourage the pipe to be self cleansing in frequent flows:

Table 3-K – Minimum and maximum pipe velocities

Flow velocities for pipes Flow condition	Absolute minimum[1] m/s)	Desirable minimum[1] (m/s)	Desirable maximum[2] (m/s)	Absolute maximum[2] (m/s)
Partially full	0.7	1.2	6.0	8.0
Full	0.6	1.0	6.0	**8.0**

[1] *Minimum flow velocities apply to the 1 year ARI design storm, and apply to all pipe materials.*
[2] *Maximum flow velocities apply to concrete pipes. For other pipe materials, see manufacturer's advice*

Table 3-L – Minimum and maximum pipe grades

Acceptable pipe grades for pipes flowing full Pipe diameter (mm)	Maximum grade (%)	Minimum grade (%)
300 375 450	20.0 15.0 11.0	0.50 0.40 0.30
525 600 675	9.0 7.5 6.5	0.25 0.20 0.20
750 900 1050	5.5 4.5 3.5	0.20 0.20 0.20
1200 1350 1500	3.0 2.5 2.2	0.20 0.20 0.20
1650 1800 1950	2.0 1.7 1.5	0.20 0.20 0.20
2100 2250 2400	1.4 1.3 1.2	0.20 0.20 0.20

Notes:
- *Based on a Manning's n = 0.013.*
- *Based on a desirable maximum velocity for pipe flowing full of 6.0 m/s.*
- *Based on minimum velocity for pipe flowing full of 1.0 m/s.*
- *The maximum grade requirement applies to both the pipe grade and the hydraulic grade.*
- *The minimum grades apply to the pipe grade only.*

3.7.3.2 *Recommended pipe friction coefficients*

Table 3-M specifies the recommended pipe friction coefficients to be used in HGL calculations;

Table 3-M - Pipe friction co-efficient

Pipe material	Manning's "n"	Colebrook-white "k"
Steel Reinforced Concrete Pipe (SRCP)	0.012	0.6
Fibre Reinforced Concrete Pipe (FRCP)	0.011	0.3
UPVC Pipe (UPVC)	0.010	0.015
HDPE flexible pipe	0.010	0.015

3.7.3.3 *Tailwater levels*

Tailwater levels must be applied at the downstream end of the model. The model should extend suitably far downstream of the point of interest to minimise the error introduced by an assumed tailwater condition. Where determination of a tailwater level is in doubt the Developer's Representative shall consult with the City prior to proceeding with the design to confirm the value, generally:

- for free outfalls, the pipe obvert may be adopted;
- for discharge into receiving waters (excluding the ocean), tailwater equivalent to the design flood level may be adopted;
- for discharge into the ocean, tailwater equivalent to the Mean High Water Spring Level shall be adopted for minor systems, and the 5% AEP ocean level for major systems;
- for discharge into existing systems where the hydraulic grade levels are unknown, a tailwater 150mm below the natural surface/invert of kerb shall be adopted;
- for discharge into a point designed to surcharge, a tailwater level equivalent to 0.5m above the height of the surcharge may be adopted; and
- Where the outlet is limited to serving a water quality treatment device, the outlet pipe level must be in accordance with Table 3-O. The filter media's top shall exceed the 20% AEP level in the receiving waterway. If this is not possible, further modelling should be undertaken for a range of events (20% to 1% AEP) to ensure the two tailwater levels don't coincide.

Table 3-N - Outlet pipe level for water quality treatment devices

Receiving drainage system	Minimum recommended level
ephemeral waterway	300 mm above waterway invert or 100 mm above wet season water level, whichever is highest.
Perennial waterway	300mm above dry weather water level or 100mm above wet season water level, whichever is highest
natural wetland	100mm above the maximum of the ground level or wet season standing water level.
Natural ground	100mm above the maximum of the ground level or wet season standing water level.
Pipe drainage system	50mm above invert of downstream pit or pipe system and above wet season base flow levels.

Source: Table 6 of Water By Design Bio-retention Technical Design Guidelines Version 1.1.

3.7.3.4 *Headwalls and outlet structures*

Concrete headwalls shall be installed on all culverts and pipe outlets and shall not protrude above the level of the road shoulder.

3.7.3.5 *Concrete bulkheads and trench stops*

Trench stops (sand bags) and bulk heads (mass concrete) shall be provided for all stormwater pipelines with grades exceeding 7.5%. Trench stops and bulkheads are to be in accordance with the City Standard Drawing 300 series.

3.7.3.6 *Sub-soil drainage*

Sub-soil drains may be required in certain locations, particularly as intercepting drains behind kerb (including traffic island and roundabout kerb) and for drainage of the flexible pavement, and these shall be designed as per the requirements of the Austroads Guide to Pavement Technology Part 10. Sub-soil drainage lines shall be graded to suitable outlets such as stormwater pits.

For rural residential style roads, the subgrade shall be boxed out to the table drain to allow for pavement drainage. Subsoil drainage shall be installed in all other cases in accordance with the City Standard Drawing 300 series.

3.7.3.7 *Culvert design*

Road culverts should be designed in accordance with culvert hydraulics theory and Austroads Guide to Road Design Part 5. That is, the culvert capacity is determined by the flow conditions, depending on whether inlet control or outlet control governs.

Recommended design procedures are contained in Section 3 of the Concrete Pipe Association of Australia's publication: "Hydraulics of Precast Concrete Conduits Hydraulic Design Manual".

The combined capacity of the road culvert piped flow and any flows traversing a roadway that may carry vehicles shall be designed to cater for the 1% AEP. The above road capacity in addition to the culverts capacity must have a maximum safe depth of flow of 300mm above the finished surface level of the roadway.

The velocity depth product (V*d) shall be in accordance with Table 3-P for Hazard Classification H1.

Pipe capacity shall be determined to accommodate the flows from the AEP storm events specified in Table 3-B. Where culverts cross a public road, guide posts shall be installed either side of culverts on both sides of the road.

Driveways and property accesses shall be designed in accordance with Section 2.7.7.

3.7.4 Pipeline materials

Stormwater pipes must be constructed from materials meeting the requirements identified in Table 3-O. The Developers Representative must demonstrate that any proposed pipe product meets these requirements.

Table 3-O – Pipe materials

Location	Rubber ring joint	Materials description
City road drainage	✓	Concrete (RCP), installed to manufacturers Specification, minimum 100 year design life
		HDPE flexible pipes, installed to TfNSW R23 Specification, minimum 100 year design life
Inter-allotment drainage	✓	City drainage materials requirements or uPVC. uPVC pipes are not to be used for other than roof water drainage in road reserves and public open space. Minimum 50 year design life Concrete (FRCP), rigid pipeline may be installed to manufacturers Specification.

The appropriate pipe class must be determined based on the available cover and design loading.

3.8 Design of overland drainage systems

Catchment areas to each overland drainage line shall be determined from terrain information and proposed property boundaries. A site inspection should always be made to verify the terrain information and assess the likelihood of any flow path deviations which may occur as a consequence of existing or proposed developments. Changes to flow paths can occur as a result of the construction of fences, earth bunds, retaining walls, buildings etcetera after the construction phase of the subdivision. The impact of these changes shall be considered at the design stage.

Design of open channel drains shall be in accordance with Chapter 2 of Book 6 of ARR 2019, having regard to driveways and property accesses requirements in Part 2 of these Standards. Open channel drains in overland minor systems shall have a minimum floor width of 1.0m and desirable batter slopes of 6H in 1V and not exceeding 4H in 1V to allow for maintenance and mowing, provided the Hydraulic Grade Line of the drain is below the bottom of all pavement layers in the adjacent pavement.

3.8.1 Hydraulic design – major system flows

The capacity of major systems shall be calculated using Manning's equation (Figure 4.6 of QUDM), Izzard's equation (Figure 4.7 of QUDM) or through modelling using commercially available software such as DRAINS and TUFLOW. The software utilised shall be commensurate with the scale of the development. Eg TUFLOW shall be utilised for major system assessment at a precinct level scale.

The hydraulic design of major system open channels shall be in accordance with Chapter 2 of Book 6 of ARR 2019.

Major flows shall follow a designated flow path, which typically shall be:

- A road if the catchment area is sufficiently small;
- A defined drainage reserve or open channel generally following natural drainage contours where it is impractical or unsafe for a road to carry the excess flows;
- A piped underground system designed in accordance with Section 3.7 where it is impractical or unsafe for the major flows to follow overland flow paths;
- Open channel drains for rural residential layouts; or
- A natural watercourse (blue line on topographic map) where the Developer's Representative can demonstrate that the development has no impact to private property or City infrastructure downstream.

3.8.2 Major system design criteria

The design of major systems must meet the design limits shown in Table 3-P.

Table 3-P – Major flow design limits

Location	Design limit
All areas routinely accessed by vehicles and people, including vulnerable people (such as children)	H1 Hazard Classification as defined in Section 7.2.7 of Book 6 ARR2019 for the critical 1% AEP event
All areas routinely accessible by the public but not subject to vehicle traffic	H2 or lower Hazard Classification as defined in Section 7.2.7 of Book 6 ARR2019 for the critical 1% AEP event

Areas without routine public access but without exclusion fencing	H3 or lower Hazard Classification as defined in Section 7.2.7 of Book 6 ARR2019 for the critical 1% AEP event
Where roads convey major flows	Maximum flow depth to be top of kerb or 200mm above top of kerb where the footway can cater for the depth of overland flow and where it is demonstrated that it will not cause any flooding issues to adjacent lots.
Structures and entrances to underground car parks	For floor levels on structures and underground carparks a minimum freeboard of 0.3m is required above the 1% AEP flood event. A higher freeboard may be required in areas of mainstream overland flooding.
All major systems	Freeboard to be the greatest of: • 150mm • Flow velocity head • The additional capacity required to convey the relevant climate change flow as calculated using section 3.6.3.1.

3.8.3 Open channel design

Open channels include overland minor system flow paths and overland major system flow paths such as table drains, formed concrete lined channels, turf lined swale drains etcetera. Open channels shall be designed in accordance with Chapter 2 of Book 6 of ARR 2019 and the following.

3.8.3.1 *Flow velocities*

Designs shall be based on sub-critical flow with a Froude Number no greater than 0.8.

Maximum permissible velocities for turf lined channels should use the values in Table 3-Q or a detailed assessment may be undertaken using HEC-15.

Table 3-Q - Permissible velocities for turf lined channels

Channel gradient (%)	Maximum permissible velocity (m/s)
1	1.5
2	1.4
3	1.3
4	1.2
5	1.2
6	1.1
8	1.1
10	1.1
15	1.0
20	0.9

3.8.3.2 *Scour protection*

Scour protection shall be designed at all inlet/outlet points of open channels, and at any point in the channel where there is a significant change in flow conditions or there is the potential for scouring.

Details of proposed scour protections shall be nominated on the plans and be in accordance with Austroads – Guide to Road Design 5B and be approved by the City.

3.8.3.3 *Turf stabilising*

The floors of all open channels including the walls of batters 0.5m above floor level shall be designed with turf of an appropriate species subject to Section 3.8.3.2. The remainder of internal and external batters of open channels shall be provided with topsoil and seeded with appropriate grass species, or shall be designed with a geotextile material with a minimum life expectancy of two (2) years.

The details and specification for fixing of geotextile are to be submitted with the design documentation.

Details of the proposed grass species to be used shall be included in the design drawings.

3.8.3.4 *Batter slopes and longitudinal grades*

Batter slopes of grassed open channels shall be desirably 6H in 1V and a maximum of 4H in 1V. The minimum longitudinal grade of open channels shall be 1.0% and the maximum longitudinal grade shall be such that the maximum flow velocity or hazard is not exceeded. Where batter slopes are steeper than 4H in 1V, the surface treatment for the batters shall be agreed with the City based on velocity, magnitude of flow, soil erodibility and grade.

3.8.3.5 *Road crossings*

Where open channel drains intersect with roadways, culverts shall be designed to convey flows under the roadway. Culverts shall be designed in accordance with Section 3.7.3.7.

3.8.3.6 *curvature*

Where the radius of the curvature of the channel centreline is less than 10 times the channel water surface width, additional analysis is require.

- Water surface super elevation should be considered using to following formula:

$$h_{sup} = \frac{2.3V^2}{g} \times \log_{10}\frac{R_o}{R_i}$$

where;

h_{sup}	is the difference in level
R_o	outer radius of bend
R_i	inner radius of bend

- The effects of additional shear stress and requirements for additional scour protection is to be assessed using HEC-15;
- Energy losses though bend should be calculated using:

$$h_b = \frac{2B}{R_c} \times \frac{V}{2g}$$

where;

h_b	is the channel bend head loss
B	is the channel width
V	is the average flow velocity
g	is acceleration due to gravity

R_c is centreline radius of bend

QUDM section 9.3.6 has additional guidance on the design of curved channels.

3.8.3.7 *Hydraulic design open channels*

Open channels shall be designed using backwater calculations. Recommended Manning's Roughness Coefficients "n" for Open Channels are given in Table 3-R below.

Table 3-R - Manning's values for open channels

Surface type	Manning's "n"
Concrete Lining	0.013
Grass (maintained)	0.035
Grass (unmaintained)	0.070
Earth (Clear)	0.020
Rock Lined	Refer to QUDM table 9.3.3

3.9 Inter-allotment drainage systems

Inter-allotment drainage is considered necessary in urban developments where roof water and surface water cannot be discharged directly to the street gutter or other road drainage. Inter-allotment drainage systems are intended to collect both roof water and surface water.

Inter-allotment drainage lines shall be designed for the design event specified in Table 3-B, with a fraction impervious area as per Table 3-F, and in accordance with the Building Code of Australia or Australian Standard AS3500, whichever is applicable.

The minimum size pipe is to be 225mm diameter. The design is to include manholes at intervals of not more than 60 metres. Consideration will be given to the installation of a 150mm diameter pipe where only one (1) residential lot is to be served.

A freeboard allowance of 150mm above the peak water level shall be adopted for inter-allotment pits

Under no circumstances should minor or major system drainage, piped or otherwise, discharge into an inter-allotment drainage line. Similarly, only stormwater that is captured from roofs and the surfaces of private properties are to be captured and discharged into inter-allotment drainage lines. Stormwater from roads, parks, reserves or other public places shall not be discharged into inter-allotment drainage lines.

Each lot served by an inter-allotment drainage line shall be provided with at least one grated inlet structure to permit the inlet of surface water at the most suitable point in each lot, which will correspond with the lowest surface level along the line of the inter-allotment drainage, an inlet structure is to be brought to surface level with a pit and exposed grate. From the wall of the pit a 150mm junction is to be left for the connection of roof water. The connection by the plumber of roof water to this point is to be supervised by the Principal Building Certifier.

Inter-allotment drainage pits are to be in accordance with the City Standard Drawing 300 series. Where inter-allotment drainage field inlet pits are located adjacent to a sewer manhole the pit inlet level must be a minimum of 150mm below the top of the sewer manhole lid.

The lot layout and servicing strategy should minimise the need for any inter-allotment pipe larger than 450mm in residential subdivisions.

3.10 Charged Stormwater Drainage System

Charged stormwater drainage systems rely on the difference in level (head) between the overflow of the site discharge control (e.g. roof gutter, tank overflow) and the street gutter to drive water 'uphill'.

Use of a charged drainage system for properties is not an ideal solution for the following reasons:

- The system is unable to drain areas below the point of discharge;
- Failure of the system (e.g. due to blockage, large storm events, neglect, etc) will result in stormwater runoff going downhill, away from the discharge point. This may be adverse for properties downstream;
- Piping of stormwater runoff against the natural fall of the land may redirect stormwater runoff outside the natural catchment area. This can exacerbate drainage and flooding impacts in the receiving catchment;
- The system has higher maintenance requirements in comparison to a typical drainage stormwater system; and
- In light of the above, the City has provided the following to clarify expectations of stormwater drainage measures where charged stormwater drainage systems are being considered.

3.10.1 Minor Increases in impervious area

For minor developments, that only marginally increase the percentage impervious area of the site, for example some outbuildings (sheds, garages), it may be more appropriate to provide on-site detention (OSD) in conjunction with on-site dispersal measures to maintain pre-development stormwater flow characteristics.

The OSD system must be able to store the run-off from the additional impervious area resulting from a storm event up to the 1% AEP event and outlet discharge limited, by orifice plate or otherwise, to the pre-developed flows for all storm events up to the 1% AEP. The on-site dispersal system must be suitably clear from property boundaries and structures as indicated in Figure 3. Designs of the OSD and on-site dispersal system must be prepared by an appropriately qualified professional.

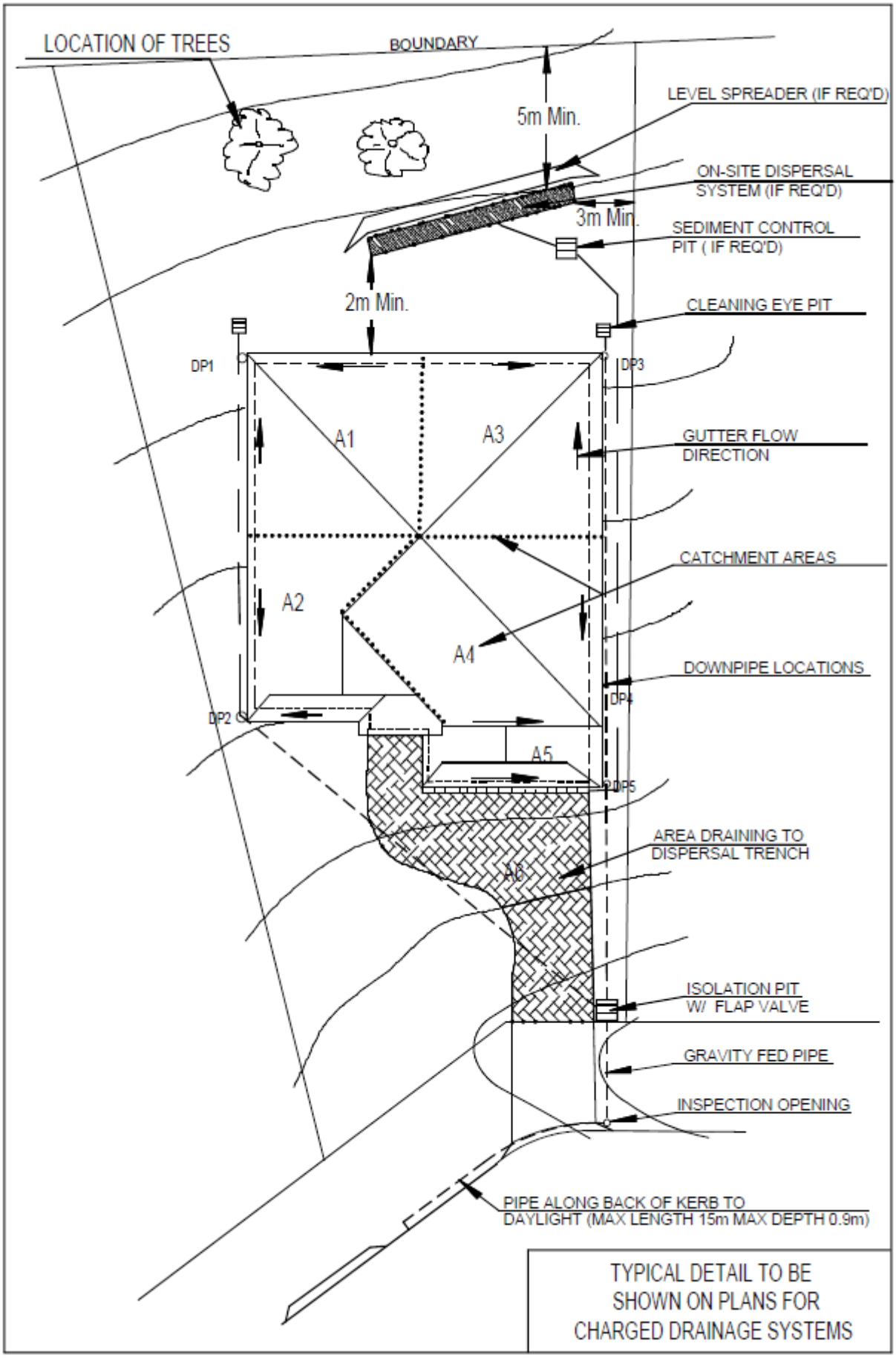

Figure 3 – Typical detail to be shown on charged drainage system plans

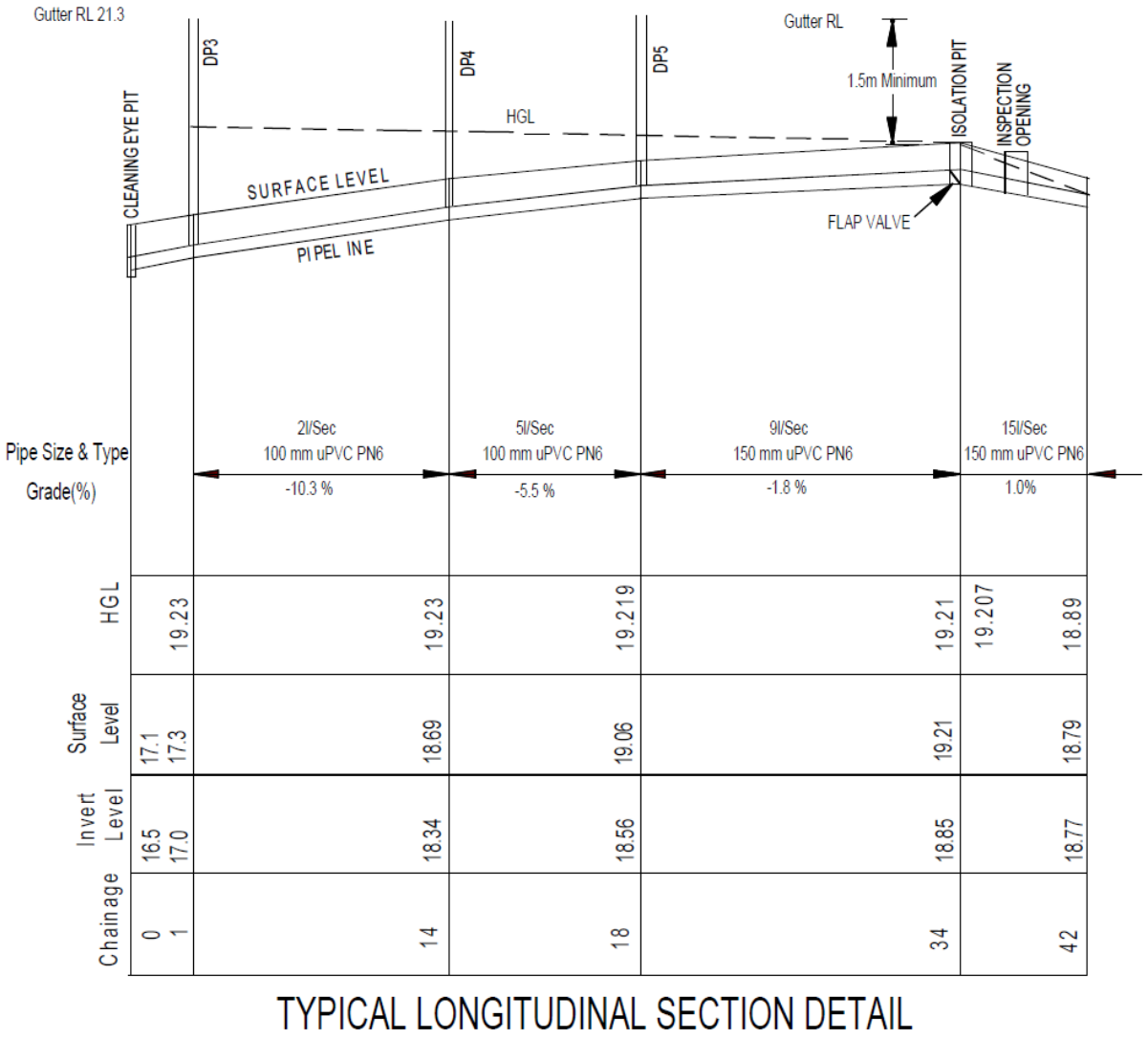

Figure 4 – Typical long section details

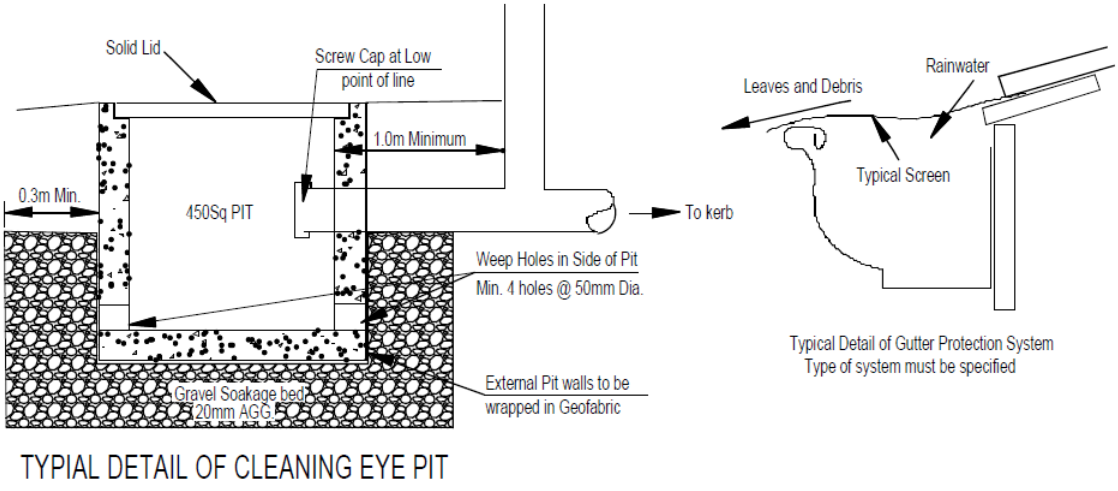

Figure 5 – Typical detail of cleaning pit and gutter protection

3.10.2 Circumstances in which a charged stormwater drainage system may be applied

A charged stormwater system, for the purposes of this Guideline is deemed to be a stormwater system utilised to discharge stormwater to the street frontage where the topography of the land is level with or falls below the fronting street kerb level.

The City will only consider a charged stormwater system if all of the following circumstances have been met. Evidence of compliance is required to accompany the Development Application.

- The City is satisfied that reasonable efforts have been made to establish a registered easement for a gravity drained system have been unsuccessful. Evidence of this may include statutory declarations or letters of correspondence which include amount of compensation offered in line with property valuation;
- The development is for one single dwelling or secondary dwelling;
- The stormwater discharge is not being redirected to stormwater infrastructure in another sub-catchment of the local stormwater network;
- The system is to be designed for a 5% AEP storm event and the roof water runoff discharge is no greater than 20 L/s;
- Must have a minimum of 1.5m head between the site discharge control (e.g. roof gutters, tank overflow) and the property boundary (highest natural ground level) and a maximum of 1.5m head between the boundary level and the base of the lowest downpipe. These height requirements may be adjusted where a detailed HGL analysis is provided demonstrating the system can adequately operate;
- The system must gravity discharge within the road reserve; and
- The stormwater must outlet to established infrastructure;

3.10.3 Standards

Stormwater drainage systems are to be designed and constructed in accordance with the requirements with the latest versions of AS/NZS 3500.3, Australian Rainfall and Runoff, these Guidelines and the National Construction Code.

3.10.4 Charged Stormwater Drainage System Details

If at the DA stage, Council accepts that a Charged Stormwater Drainage System is appropriate to be utilised for the development, the following information is required to be provided prior to the Building Construction Certificate or Civil Works Certificate being issued and must be prepared by a suitably qualified and practising Engineer.

a. A roof/site plan clearly showing catchment areas and direction of flows in gutters to downpipes.
b. Site plan showing location and sizes of all downpipes, pipes, pits and discharge points.
c. Calculations for gutter sizing, downpipe sizing, pipeline sizing including hydraulic losses on pipe system.
d. Freeboard of at least 500mm is to be allowed between the lowest roof gutter level and the hydraulic grade line at the top of the respective downpipe
e. Calculations showing the discharge flow rate to the kerb and that the subsequent gutter flow widths are in accordance with Council's specifications.
f. A longitudinal section of the pipe system showing:
    i. Site discharge control (e.g. roof gutter, tank overflow) levels
    ii. The system completely sealed and details of cleaning eye pit at lowest point in charged system. See note 6.
    iii. Isolation pit at boundary with invert and surface levels.
    iv. Discharge point

v. Pipe sizes, capacity and design flows in each section

g. Calculations, where necessary, evidencing that post-development flow characteristics off the site are neutral or beneficial compared to the pre-existing development. See note 5. If the system utilises an absorption trench, it must be designed by a qualified Civil Engineer based on soil permeability testing.
h. The pipe system including downpipes must be fully sealed and constructed from suitably durable materials e.g. sewer grade PVC or pressure pipes.
i. Gutter guards must be installed on all roof gutters and specified on drawings.
j. All gutters must have an overflow point or pressure relief to ensure that flooding does not occur within the roof cavity or eaves of a building.
k. All plans must be in AHD levels.
l. Maintenance schedule to be provided detailing timing of maintenance activities to all system components.

Notes:

1. (a), (h), (i), (j) are applicable to stormwater discharge directly from the gutter (e.g. not from a tank overflow).
2. Exposed aerial drainage will not be approved by Council, except for gutter and vertical downpipes.
3. The system is to be pressure tested prior to backfilling.
4. Discharged by gravity in the road reserve may be achieved by exiting the stormwater pipe from the property perpendicular to the back of kerb whereby it follows the kerb to daylight. An inspection opening must be provided at the change of direction at the back of kerb. The pipe must be no deeper than 0.9m, 15m in length adjacent kerb and maintain necessary clearances to existing infrastructure e.g. subsoil drainage.
5. The on-site dispersal system should have a minimum length of 4m and be located in a position on-site that is responsive to the form of the land. The system must also be located a minimum 3m clear of any property boundaries, 2m from the downstream side of any building and 5m from the upstream side of any building unless geotechnical investigation can justify otherwise.
6. A feature of a charged system is that it holds stagnant water for a period of time until the next rain event. The ability to clean a charged system is therefore very important.
7. A backflow prevention device must be installed at the location of the inlet pipes to the isolation pit to minimise mosquito nuisance.

3.10.5 Finalising the charged stormwater drainage system

Prior to the issue of an Occupation Certificate**,** the maintenance considerations of the charged stormwater drainage system are to be registered on the title of the lot through a positive covenant. In conjunction, a restriction on title is to be registered that ensures the drainage system is not modified from the approved design without the City's consent. These title encumbrances are in accordance with section 88E of the *Conveyancing Act 1919*. See Appendix 1 for standard terms of the positive covenant and restriction on title.

3.11 Stormwater detention and retention

3.11.1 Definitions

- Stormwater detention is defined as the process of temporarily holding and/or controlled release of stormwater through the use of a hydraulic storage system;
- Stormwater retention is defined as the reduction in flow volume by long-term storage or discharge to an alternative outlet such as evaporation or infiltration;
- A large subdivision and development is defined as a development consisting of greater than 5 potential dwellings or units.
- A small development is defined as a development consisting of less than or equal to 5 potential dwellings or units and a predeveloped lot size less than 2000m^2; and
- Dwelling is defined in the Coffs Harbour LEP 2013.

In subdivisions or developments larger than single allotments, stormwater detention or retention typically involves the construction of detention/retention basins to retard flows and control outfall.

In small developments, stormwater retention or detention typically involves the design of on-site detention structures and systems.

3.11.2 General design requirements and considerations

Designers must demonstrate that a development does not increase the design peak flows for any event probability at any point/location downstream. Downstream points/locations of interest include existing drainage infrastructure but this requirement can be relaxed if the existing infrastructure has adequate capacity for the developed flows.

Stormwater detention or retention is only to be considered as a preferred design option where it can be demonstrated that there are no other practical solutions to capture and control stormwater flows, or where there is a demonstrated environmental benefit with their use. The Developer's Representative shall provide details of all other design strategies explored prior to the selection of stormwater detention or retention as the preferred design option.

Where it is intended to utilise stormwater retention/detention structures, details of such shall be included in the stormwater servicing strategy, including details of the requirements for a suitable stormwater retention/detention system and details that demonstrate that the system can be integrated into the development and the surrounding environment. Where retention structures are proposed, the servicing strategy shall include a water usage plan, details of any top-up water supplies, and capacity modelling data.

Detailed design and documentation of retention/detention systems are to be prepared by the Developer's Representative. A detailed hydrological and hydraulic analysis is required for all detention/retention systems and shall be submitted along with the detailed design documentation.

Computer software shall be a 'recognised industry standard' software program. A comprehensive list of set-up parameters used to obtain results from the software is to be submitted along with the detailed input and output documentation.

Land that has been identified for stormwater retention/detention basins to be maintained by the City, whether existing or proposed, must be shown on a Plan of Subdivision as a Drainage Reserve and vested to the City as operational land.

In circumstances where detention basins are not to be maintained by the City and are located within land that is common property, a covenant as per Section 88B of the Conveyancing Act 1919 (as

amended) shall be placed on each benefiting allotment to ensure the performance of the structure is not compromised by any act, or failure to act, by the body corporate.

Detention basins shall be designed to drain completely.

Retention/detention basin areas shall not be used in calculations for public open space requirements unless specifically designed to be usable and approved by the City.

When a retention/detention basin is required for any development, the basin and any overland flow paths shall be constructed as part of stage one works. Where it can be demonstrated to the City that a retention/detention basin is not required as part of the first stage works; plans, computations, and relevant approvals must be provided to confirm the alternate method of outfall and/or storage capacity.

3.11.3 Stormwater retention/detention in large subdivisions and developments

3.11.3.1 *Objectives*

The objectives to be achieved through the design of stormwater retention/detention are as follows:

- To protect property and infrastructure from flooding occurring from a nominated rainfall event by the provision of retention/detention basins;
- To limit, as much as possible, the number of retention/detention basins servicing an area to reduce the City's future maintenance expenditure;
- To protect the City's existing stormwater drainage assets from exceeding their design capacity and overloading as a result of new developments, which increase the amount of stormwater runoff being generated from a particular property;
- To protect the public from risk of injury or death;
- To standardise the type and operation of structures, basins and outfalls associated with retention/detention; and
- To design aesthetically pleasing drainage structures having regard to the area that they will be located in.

3.11.3.2 *Dam safety risk assessment*

A risk assessment report is to be prepared by the Developer's Representative for all retention/detention systems to assess the likelihood and consequence of structural failure of the system. A risk assessment should be undertaken in accordance with the principles detailed in AS ISO 31000, 2018 Risk Management. The risks associated with these structures shall be assessed over the entire life of the structure and not just the construction.

The Developer's Representative shall be responsible for deciding on the action required in response to the risk assessment report and its recommendations; however, consultation with the City is encouraged if recommendations are complicated, require community involvement, or have significant ongoing maintenance issues.

The Developer's Representative is responsible to ensure that any new detention/retention basin does not become a declared dam under the Dams Safety Act 2015. The Developers Representative must provide an assessment of the basin demonstrating that failure of the basin it is not likely to:

- cause major or catastrophic level of severity of damage or loss; or
- endanger the life of a person.

as described in Government Gazette of NSW No. 137 of 8 November 2019.

A copy of the risk assessment report, with recommendations shall be provided to the City with the detailed design documentation. The City will not undertake a review of detention/retention basin designs without a Risk Assessment Report.

3.11.3.3 *Location*

Retention/detention basins are intended to increase the volume of water temporarily stored in the catchment and therefore should generally not be located in areas subject to flooding.

The City's preference is for off-stream retention/detention basins. Retention/detention basins shall not be located "on-stream" in the flow path of natural drainage courses or designated overland flow paths unless approval is granted from the Department of Climate Change, Energy, the Environment and Water (DCCEW) and application and subsequent approval is granted by the City. The City is not obliged to approve on-stream systems if DCCEW approval has been granted. The location of retention/detention basins shall have regard to:

- The physical dimensions required for storage volume including the flattest possible batters, access to the basin bed, and maintenance of batters and edges;
- Pre-developed catchments;
- Existing developed catchments;
- Existing drainage including piped, swale drains, or flow paths;
- Existing and proposed drainage easements;
- Ground water depth and seasonal fluctuations;
- Subsoil characteristics;
- Location and point of discharge;
- Soil type and seepage rate;
- Land uses and zoning;
- Effect of overland flows external to the catchment;
- Potential risk or effect on people, fauna and flora;
- Amenity of the area;
- Benefiting landholder issues;
- Provision of a suitable discharge method by gravity only;
- Maintenance issues and all-weather access;
- Water quality;
- The location of overland flows into the basin and the treatment(s) to minimise erosion;
- Inlet velocity and the need to install energy dissipation structures; and
- Flood level information or historical flood data.

Approval of the proposed location of any retention/detention structures will only be subject to the City being satisfied that each of the above criteria has been satisfactorily addressed.

3.11.3.4 *Design criteria*

All retention/detention structures are to be designed utilising:

- Hydrographs produced by an acceptable method of unit graph theory or mathematical modelling; and
- Flood routing through the structure.

Retention/detention structures shall be designed to maintain the existing undeveloped discharges for storm durations and frequencies from 0.63% (1EY), 50%, 20%, 10, 5%, 2% and 1% AEP.

The methods described in Section 3.6.3 of these Guidelines may be used to calculate permissible peak flows.

Retention/detention structures shall be designed for the peak 1% AEP storm with consideration of the sensitivity of the design given to 0.5% AEP events.

The peak storm duration with retention/detention structures is to be confirmed by the Developer's Representative. The critical duration is likely to be longer than without retention/detention. A graph showing the range of peak flood levels in the structure and peak discharges from the structure are to be provided for all storm events examined. Consideration must be given to areas downstream to ensure that changes in timing of peak flows at the confluence of downstream reaches is not adversely impacted by construction of the structure.

A sensitivity analysis must be undertaken for a range of variables (catchment roughness, link lags etc.) to determine how sensitive the design is to minor changes in these variables.

Rainwater retention tanks either installed or intended to be installed as part of the development including installations as part of BASIX requirements shall not be used in detention design calculations. All such tanks must be considered as being full in design calculations.

3.11.3.5 *Freeboard*

Basin freeboard shall be considered by the Developer's Representative as a minimum and the following conditions shall be met:

- Minimum freeboard above the 1% AEP critical duration top water level shall be 500mm for earth structures and 300mm for concrete structures;
- The lowest kerb inlet level for the upstream stormwater system within the basin catchment area shall be higher than the 1% AEP critical duration top water level;
- If the top water level in the structure resulting from the minor storm event is higher than the invert of the lowest inlet pipe to the basin, tail water conditions shall be considered;
- Overland flow path for a major storm shall be designed such that the minor system contribution to flow is ignored, i.e., inlet pipe is blocked; and
- All spillways and associated overland flow paths must be designed with a minimum freeboard of 150mm.

3.11.3.6 *Spillways*

Spillway design must be of sufficient capacity to safely convey a minimum 1% AEP peak basin inflow without failure of the embankment. The design of the spillway should not consider any low level outlet discharge in the calculations i.e., spillway calculations shall include a blocking factor of the low level outlet structure(s) of 100%. Spillway structures are to be designed as a concrete lip (minimum 2m width) with erosion protection measures. Scour protection of the spillway embankment is to be provided in accordance with the predicted velocities with rock protection mattress shall be provided as a minimum.

Consideration shall also be given to the sensitivity of the design for 0.5% AEP events where significant impact to downstream infrastructure or potential loss of lives exists.

The spillway design for on-line basins shall consider the cumulative effect of the 1% AEP inflows from all upstream basins.

3.11.3.7 *Retention/detention structure depth*

The depth of excavations for retention/detention structures shall be limited such that loss or infiltration to the demonstrated water table level will not occur.

The depth of retention/detention structures shall be considered and documented in accordance with Section 3.11.3.2.

Retention/detention structures may require an impervious lining or other treatment to prevent the ingress of groundwater. Groundwater may not be extracted and used.

Any structure that penetrates the demonstrated groundwater zone such as footings and drainage shall be appropriately treated to prevent possible damage caused by contact with ground water.

The depth of all retention/detention structures for which the public have access to will be determined having regard to the safety of persons who may fall into or enter the structure during times of operation.

3.11.3.8 *Batter slopes in earthen basins*

Desirable batters for detention basins shall be 6H in 1V for both cut and fill situations.

The City will accept batter slopes up to 4H in 1V which is the maximum batter slope that is considered maintainable.

Maintenance and management Plans shall be prepared for all detention basins and submitted to the City for approval.

The floor of detention basins shall be graded in all directions to the outlet point of the structure. The minimum grade at any location of the basin floor to the outlet point shall be 0.5%.

3.11.3.9 *Inlet structures*

Any inlet pipe to a basin shall be fitted with a headwall and an approved structure that will allow debris to escape whilst impeding the entry of persons. Access requirements in accordance with 3.11.3.11 shall be followed.

All inlet headwalls shall be fitted with an approved post and rail barrier to prevent falls and to identify the location of headwalls and wingwalls.

3.11.3.10 *Low level outlet structures*

Culvert outlets from retention/detention structures are to be rubber ring jointed with no lifting holes. Cut-off walls and seepage collars are to be provided as necessary. Pipe and culvert bedding are to be specified to minimise permeability.

Outlet structures must consider upstream catchment land uses in consideration of potential blocking. Outlets must be designed with debris and scour control devices and energy dissipation structures.

Outlets are to be minimum 375mm RCP with orifice plate(s) installed at the outlet pit to meet peak flow design requirements.

3.11.3.11 *Access requirements*

All weather access is to be provided to the retention/detention basin and any associated structures to enable maintenance to be carried out. The access should be provided in such a manner that there is

no need to reverse a maintenance vehicle at any time. The access should be provided so that maintenance of any portion of the basin and its associated works can be safely carried out. A 3.0 metre width traversable allocation shall be provided around the perimeter of all retention/detention basins.

3.11.3.12 *Fencing and security*

Public safety issues are to be considered and documented, including :

a) Maximum water depth shall be 1.2m in the 1% AEP event;
b) Internal basin side slopes shall be 6H to 1V as a preferred maximum slope;
c) Internal basin side slopes steeper than 6 H to 1 V and the standing water depth in a 1% AEP is greater than 300mm shall require security / safety fencing;
d) Internal batter side slopes of 4H to 1V shall be permitted as an absolute maximum subject to the approval of a delegated officer from the City's Engineering section;
e) Where retaining walls with height greater than 600mm are provided on a basin, safety fencing shall be provided;
f) Maximum velocity through the basin during the 1%AEP event should not exceed 0.3 m/s
g) Inlet / Outlet structures shall be located at extreme ends of the basin with short-circuit of flow further minimized by use of baffles
h) Appropriate hazard / safety signage and depth indicators are to be installed.
i) Flow intakes to be protected considering blockage and safety issues

3.11.3.13 *Landscaping*

The floors of all retention/detentions structures and walls of batters 0.5m above floor level shall be appropriately stabilised to prevent erosion and scouring with turf of an appropriate species. Refer to Section 3.8.3.3. The remainder of internal and external batters of retention/detention structures shall be provided with topsoil and seeded with appropriate grass species.

A fully detailed landscape plan for all retention/detention basins shall be submitted as part of the landscaping plans required in Part 6 of these Guidelines.

3.11.3.14 *Signage*

Approved signage shall be provided at all retention/detention basins indicating the depth of water and any hazard to the community. Signs are to be erected such that two signs and one depth indicator are visible from any one point of the basin embankment at any time.

3.11.3.15 *Maintenance*

Access covers and grates are to be designed to enable access for maintenance and cleaning. Any large pipe inlets into the basin shall be grated in a satisfactory manner to prevent entry to the stormwater drain. The grates shall be designed so that they can easily be maintained and so that they will not cause blockages during storm events.

Pits, pipes, screens etcetera that require regular cleaning and maintenance shall be readily accessible with all openings of suitable geometry to allow for cleaning and removal of debris and silt accumulations.

3.11.4 Geotechnical requirements

Due consideration must be given to the geotechnical aspects of retention/detention structure design, and a geotechnical report shall be prepared by a suitably qualified and experienced Geotechnical Engineer shall be submitted with the detailed design documentation.

3.12 On-site detention systems in small developments

3.12.1.1 *Objectives*

On-site detention (OSD) will only be considered for small developments as defined in Section 3.11.1.

The objectives of OSD systems are as follows:

- The capacity of existing drainage infrastructure shall not be exceeded as a result of developments which increase the volume and rate of stormwater runoff beyond the capacities originally designed for;
- The likely cumulative impact of similar developments shall not adversely impact on the capacity of the existing drainage system;
- That OSD systems are able to be effectively maintained by landowners and provide a cost-effective method of meeting the other requirements of this section;
- Provide a simplified method for designers, builders and owners to determine the City's requirements for on-site detention in relation to volume of detention and permissible rate of discharge to the City's drainage system; and
- That OSD systems meet necessary WHS guidelines.

3.12.1.2 *General*

On-site detention systems may be required in the following types of small development:

- Any development on an existing lot where post-developed flows exceed existing flows;
- Any development where the capacity of the drainage network downstream of the development will be exceeded by post-developed flows from the development;
- Any development where generated stormwater flows could adversely impact on private property irrespective of the capacity of the downstream drainage network; and
- Any areas identified by the City as drainage problem areas.

On site detention tank systems shall also meet the following requirements:

- The orifice for the detention tank must be readily accessible via detachable plumbing fittings. The orifice outlet diameter shall be clearly indicated on the detention tank signage plate;
- An 88B instrument (or similar) shall be provided for the dedicated detention tank for each unit or dwelling;
- All roof water shall be directed to the proposed (BASIX) water storage tank. Any roof area that is not directed to the Basix tank, shall be connected to the dedicated detention tank;
- All stormwater overflow from the (BASIX) water storage tanks are to be connected to a proposed dedicated detention tank for each unit; and
- On the dedicated detention tank to be provided, signage installed on the tank to clearly indicate the detention tank purpose, refer to Section 3.12.1.6.

Where an OSD system is required for a development, the entire development area is to be considered in OSD calculations. All stormwater runoff, including any bypass should be included in the OSD calculations. Rainwater tanks shall not be included in detention volume calculations. Detention tanks must be dedicated tanks separate to rainwater tanks.

3.12.1.3 *Design criteria*

OSD systems shall be designed to maintain the existing undeveloped discharges for the 50%, 20%, 10, 5%, 2% and 1% AEP storm events.

All roof water plumbing including tank connections shall cater for the 10% AEP year, to AS 3500. All roof water and detention tank stormwater calculations shall be for the 50%, 20%, 10, 5%, 2% and 1% AEP storm events. Stormwater calculations in greater than 10% AEP shall consider the roof water system to be at the 10% AEP standard.

The methods described in Section 3.6.3 of these Guidelines may be used to calculate permissible peak flows.

The design documentation must clearly describe the proposed storage system and location. The developer shall provide computations that demonstrate the volume of detention required and the permissible rate of discharge.

3.12.1.4 *Overflow*

A suitable overflow system must be provided to cater for a blockage in the system. All overflows are to be directed away from buildings, adjoining properties and associated infrastructure and must drain to the legal point of discharge. The overflow system shall be designed to cater for all storms up to and including a 1% AEP storm event.

3.12.1.5 *Discharge control point*

Orifice plates shall be designed to be corrosion resistant stainless steel. The outlet is to be protected by a screening device to avoid blocking.

3.12.1.6 *Signage*

Each OSD system is to be marked by a plate in a prominent position which identifies the OSD system and that it is an offence to reduce the volume of the structure or interfere with the orifice plate that controls the outflow.

The detention tank plate should include the following:

- This is an onsite dedicated detention tank required by the City;
- It is an offence to reduce the volume of the detention tank or to interfere with the orifice that controls outflows;
- The detention tank orifice diameter is xx mm; and
- This plate must not be removed.

3.12.1.7 *Maintenance of on site detention systems*

Where an OSD system is required the landowner shall be required to maintain these to the satisfaction of the City. A plan of required maintenance procedures and practices for OSD systems shall be supplied with the design documentation and included in any community management statement.

3.12.2 Underground OSD systems

All underground storage tanks shall have suitable access for maintenance and comply with the Occupational Health and Safety Act 2000 and Confined Spaces requirements.

All underground storage tanks shall comply with the Public Health Act 1991.

Access to underground storage tanks must be secured with a grate or cover and fastened to prevent unauthorised access. Access points are not to be concreted, paved, built over or otherwise obstructed.

Access openings must be a minimum:

- 600 mm by 600 mm for storages up to 600 mm deep; or
- 900 mm by 900 mm for storages greater than 600 mm deep.

The floor of underground storages must be graded so that the storage empties under gravity and water does not pool in the tank.

Underground storage tanks may face corrosion and acidic attack. The storage tank type must be resistant to the environment in which it is placed. This applies to both above and below ground installation.

Underground storage tanks must not be installed over or within 1.0m of a water main, sewer main, on-site wastewater system or on-site wastewater disposal field.

Underground storage tanks should not be installed within 1.0m of the drip line of trees. A root barrier shall be installed if underground storage tanks are located adjacent to trees.

Where OSD facilities are located under driveways and parking areas, consideration must be given to the finished surface levels and vehicular access requirements.

OSD storage shall not be installed into the groundwater zone unless detailed computations are provided and approved by the City.

3.12.3 Above ground OSD systems

Above ground OSD system may comprise of one or a combination of the following:

- Driveways and carpark areas;
- Tanks of varying configurations;
- Excavated earthen storages;
- Grassed or landscaped areas; or
- OSD system with a Primary (lower) Orifice Outlet and a Secondary High Early Discharge (HED) Outlet.

Above ground tank systems must be separated from BASIX rainwater tanks. Combined rainwater tanks with built in detention offset will not be permitted.

3.12.3.1 *Paved surfaces*

- Water ponding depth is to be limited to a depth of 150 mm in areas where vehicles are parked and 180 mm in areas where vehicles are not parked;
- The storage area shall be totally impermeable; and
- Where the surface may be used for traffic or pedestrian movements, flows from minor events up to the peak 20% AEP event are to be stored underground.

3.12.3.2 *Landscaped areas*

- OSD systems shall not extend across lot boundaries;

- OSD requirements may include the following:
    - Water depth shall be no deeper than 1200 mm;
    - Water depth greater than 500 mm shall be fenced with child-proof fencing;
    - A maximum batter slope of 6H in 1V or alternatively a terraced slope system so that the maximum terraced depth is no greater than 300 mm; and
    - The City may consider alternative designs to the above requirements, however public safety shall be addressed and child-proof fencing may be required.
- The floor of the OSD area shall not pond water;
- The bunded wall of the OSD area must be impervious; and
- Where vegetated the storage capacity shall be increased by 20% to allow for vegetation growth.

3.13 Drainage corridor tenure

Where inter-allotment stormwater drainage, piped or otherwise, is designed to discharge onto land other than an existing drainage easement, drainage reserve, public road or other legal point of discharge or public place as approved by the City, it shall be the responsibility of the developer to obtain a drainage easement through such land, sufficient in dimension to convey the drainage to an easement, natural watercourse or public place, and to transfer easement rights thereover to each upstream beneficiary of the inter-allotment drainage line. The City is not to be named as a beneficiary of easements for the purposes of inter-allotment drainage.

Where minor system stormwater drainage, piped or otherwise, is designed to discharge onto land other than an existing drainage easement, drainage reserve, public road or other legal point of discharge, it shall be the responsibility of the developer to obtain a drainage easement through such land, sufficient in dimension to convey the drainage to an easement, natural watercourse or public place, and to transfer easement rights thereover to the City.

Where major system stormwater drainage, piped or otherwise, is designed to discharge onto land other than a roadway, an existing drainage reserve or other public place, the land shall be dedicated as a drainage reserve, sufficient in dimension to convey the drainage to a natural watercourse or other public place, and to transfer ownership thereover to the City.

For overland flow paths onto lots greater than 1ha a discharge easement being the minimum flow width including freeboard and minimum of 1m in length shall be created benefitting the upstream property or reserve. Creating a legal point of discharge onto the downstream property or reserve.

Where it is intended to create drainage easements or drainage reserves in a subdivision or development, a notation shall appear on the engineering drawings and subdivision plan creating the easement or easements pursuant to Section 88B of the Conveyancing Act, 1919 as amended.

Where a drainage easement to the benefit of the City lies within a development that does not involve the opening of a new road, the developer shall transfer to the City any drainage easement provided in the subdivision and execute a transfer and grant of easement in favour of the City pursuant to Section 88B of the Conveyancing Act, 1919 as amended.

Where stormwater is designed to discharge into a public park, an open grassed channel shall be provided to meet the minor/major design requirements of these Guidelines.

The subdivision certificate will not be released until the above requirements have been complied with, and all fees and contributions have been paid.

Where diversion banks are required they shall be protected by a restriction of the use of land that cannot be modified without the permission of the City.

3.13.1 Width of easements and reserves

Table 3-S - Corridor width and type

Type of drainage	Minimum width	Corridor type
Inter-allotment drainage	1.5 metres for depths to invert less than 1.0 metre. 3.0 metres for depths to invert greater than 1.0 metre	Easement identifying lots benefiting
Piped drainage (greater of)	Width of trench plus twice the depth of trench; or	Easement benefiting the City or Drainage reserve
	3.0 metres (pipe diameter ≤ 600)	
	5.0 metres (pipe diameter > 600)	
Turf lined open channels – batters steeper than 4H:1V	6m plus top width of 1% AEP design flow with freeboard	Easement benefiting the City, Road reserve or Drainage reserve
Turf lined open channels – batters flatter than 4H:1V	1m plus top width of 1% AEP design flow with freeboard	Easement benefiting the City, Road reserve or Drainage reserve
Concrete lined open channels including flow paths through private property.	1m plus top width of 1% AEP design flow with freeboard	Easement benefiting the City, Road reserve or Drainage reserve
Any combined easement (including that with inter-allotment drainage)	The width shall be increased to provide the greater of 1.5m between pipe centrelines 1000mm OD to OD.	Easement identifying lots benefiting or Easement benefiting the City or Drainage reserve

For each proposed drainage corridor, the City will determine whether it shall be a drainage reserve or easement on a case by case basis.

3.14 Water Sensitive Urban Design

3.14.1 General

Water Sensitive Urban Design (WSUD) integrates land and water planning and management into urban design to improve opportunities for infiltration and to reduce runoff and pollutants entering the natural watercourses. WSUD is based on the idea that urban development must address the sustainability of water and minimise impacts on the water environment.

The principles of WSUD can be adopted at a lot, precinct and/or regional scale and include:

- detaining, rather than rapidly conveying stormwater;
- capturing and using rainwater and stormwater as alternative water sources;
- using landscaping in our streets to filter water;
- water-efficient landscaping; and
- protecting water-related environmental, recreational, and cultural values.

WSUD applies to the following development types[1]:

- Subdivision of land with four or more resulting lots;
- Residential accommodation comprising four or more dwellings and/or units;
- Commercial and industrial development where:
    - New development comprises a total impervious[2] area greater than 800m^2; and
    - Alterations and additions to existing development[3] comprises an increase in the site impervious area by more than 400m^2 and results in a total impervious area greater than 800m^2.
- Tourist development where:
    - New development comprises a total impervious[2] area greater than 900m^2; and
    - Alterations and additions to existing development[3] comprises an increase in the site impervious by more than 450m^2 and results in a total impervious area greater than 900m^2.
- Public administration buildings where:
    - New development comprises a total impervious[2] area greater than 800m^2; and
    - Alterations and additions to existing development[3] comprises an increase in the site impervious by more than 400m^2 and results in a total impervious area greater than 800m^2.
- Other development types not specifically identified in the points above, where:
    - New development comprises a total impervious[2] area greater than 800m^2; and
    - Alterations and additions to existing development[3] comprises an increase in the site impervious area by more than 400m^2 and results in a total impervious area greater than 800m^2.
- Carparks where not ancillary to other development to which this section applies with a total impervious area greater than 800m^2
- Sealed roads comprising a total impervious area greater than 800m^2
- Service stations, fuel depots, or any other developments that pose a higher risk of oils and hydrocarbons contaminating downstream waterways must install devices that treat these pollutants according to the targets specified in Section 3.14.2.

[1] The requirements above do not apply to development of lots within a subdivision which comprises an approved stormwater management plan that achieves the performance criteria in this guideline, However the performance criteria may be applied if the development of a lot significantly differs for the assumptions in the stormwater management plan.

[2] Impervious area includes roofs and hardstand areas

[3] The performance criteria in this section only applies to the alterations and additions, not the existing development

[4]Development classified as small in scale is encouraged to use Water By Design's Deemed to Comply solutions.

3.14.2 Performance Criteria

All development which WSUD applies to shall comply with the principles, targets and detention requirements as detailed in below:

3.14.2.1 *WSUD Objectives*

- Implement best practice stormwater management techniques;
- Maintain natural drainage patterns;
- Maintain watercourses in their natural form. I.e. watercourses should not be piped or channelled;
- Maintain adequate and intact vegetation buffers around waterways and sensitive areas, as per the requirements of the Coffs Harbour Development Control Plan (DCP); and
- Support designs that reduce maintenance impacts through integration into the public realm, which provide public benefits while ensuring a catchment sensitive, holistic, and economical design outcome[1].

3.14.2.2 *Pollutant reduction targets*

Minimum reduction in average annual pollutant loads from a development site (comparing untreated developed case versus treated developed case are:

- 80% reduction in total suspected solids (TSS);
- 60% reduction in total phosphorus (TP);
- 45% reduction in total nitrogen (TN);
- 90% reduction in gross pollutants (size >5mm); and
- 90% reduction in total hydrocarbons[2]

For small scale developments catchments, applicants should simply follow the Deemed to Comply solutions which have been tested, and satisfies the aforementioned pollutant reduction targets.

Additional scenarios:

- The City is unlikely to approve subdivisions which rely on WSUD measures being installed in private lots as a component of future building works to achieve any short fall in the pollutant reduction targets (With exception of community title subdivisions).
- The City discourages proposals which utilise piecemeal WSUD solutions to achieve the pollutant reduction targets. For example, if a subdivision proposes excessive bio-retention basins, significant justification needs to be provided which demonstrates no alternatives or consolidation is possible.
- For Greenfield subdivisions, the first preference is achieving the pollutant reduction targets referenced above. However, the City acknowledges that some Greenfield sites may present significant challenges. If the applicant can demonstrate, through modelling, that meeting these pollutant reduction targets is not feasible, an alternative approach (subject to the City's approval) may be considered. This would be to achieve no net increase on the existing pollutant loads from the site. In this instance, a detailed site assessment including pre-

developed catchments and existing soil characteristics (e.g. type, seepage etc) is to be undertaken, and provided to support any development application.

- For primarily roofed sites, consideration to the utilization of green-roofs can be seen as meeting the objectives of this section, and is encouraged to be discussed with the City in the early development stages.

[1]The City may consider reductions to the pollutant reduction targets for stormwater management plans which provide a more integrated design with the public realm.

[2]Where applicable to certain development types e.g. service stations, fuel depots, or any other development that poses a higher risk of oil and hydrocarbon contaminants, see section 3.14.1

3.14.2.3 *Music Modelling*

MUSIC modelling undertaken to support development applications are to include split catchments for source nodes, not lumped catchments.

All development modelled in MUSIC are to utilise the City of Coffs Harbour MUSIC-Link, with outputs to be provided showing compliance, and evidence of using Coffs Harbour's metrological templates.

Modelling is to be undertaken on the advice shown in Water by Design (2018) MUSIC Modelling Guidelines (Consultation Draft) and any corresponding updates.

3.14.2.4 *Rural and large lot residential development*

Rural and large lot residential development does not need to comply with the pollutant reduction targets provided above. Design and implementation of the following measures is generally considered acceptable, however each application will be addressed on a case-by-case basis.

- Road reserves may comprise turfed or planted swale drainage subject to City approval. Drainage easements (where appropriate) will need to be incorporated in the design;
- On-lot measures may comprise rainwater tanks and dispersal of runoff (sheet flow) from impervious areas over grassed/planted areas. Dispersal is to include appropriate sediment and erosion control measures; and
- Other methods as approved by the City.

The City may, in certain instances, require the installation of stormwater quality measures should the individual circumstances of the development warrant such controls.

3.14.3 Deemed to comply solutions

A recommended approach by the City of Coffs Harbour is that development considered to be minor in scale may apply the South East Queensland deemed to comply scenarios as summarised below in Table 3-T. Further details can be found in the guideline Water by Design's Deemed to Comply Solutions – Stormwater Quality Management (South-East Queensland 2010).

Development which are outside of the Deemed-to-comply scenarios (e.g. larger developments), are required to submit a MUSIC model, with a Coffs Harbour MUSIC-link report which clearly demonstrates how the design achieves the pollutant reduction targets outlined in this section

Table 3-T – Deemed to comply development scenarios

Land use	Development Scenario	Scale (site area)
Residential	Residential greater than 2 lots up to 20 lots	N/A
	Residential greater than 2 dwellings (townhouse style up to 2 storeys)	< 12,500m^2
	Residential high density multiple dwelling apartments (flat, high rise)	< 12,500m^2
Commercial or industrial	Commercial and / or industrial	< 12,500m^2
Public building development	Public building development	< 12,500m^2

3.14.4 General Requirements

3.14.4.1 *Location of WSUD assets*

In addition to the requirements in Section 3.11.3.3, WSUD systems should be designed to seamlessly integrate with the local landscape or act as a prominent landscape feature where appropriate. WSUD systems should generally be located:

- Within the development property in a readily accessible location;
- Offline from natural waterways; and
- Outside any riparian zones and buffers as required by the Coffs Harbour DCP.
- Outside of any flow conveyance paths in the 1% Annual Exceedance Probability (AEP) mainstream flood event. See section 3.14.8 for more details.

Exceptions to the above will be considered on a case by case basis. Strong consideration should be given when proposing to place WSUD measures inside these areas, as they may require approvals and meet requirements from other agencies.

3.14.4.2 *Proprietary WSUD devices*

Use of proprietary devices will be considered on a case-by-case basis. These devices are not covered by deemed to comply methods, and will require sufficient evidence of compliance with the City's pollutant reduction targets at Development Application Stage.

3.14.4.3 *Vegetated WSUD systems such as swales and bioretention basins*

The City's preference is to follow the design guidelines published by Water by Design or other contemporary guidelines. Further detailed design guidance can be obtained in the "Bioretention Technical Design Guidelines" (Version 1.1, October 2014, Water by Design). See Section 3.14.8 for more information.

Where WSUD is providing dual purposes to meet landscaping requirement, the landscaping controls within the Coffs Harbour DCP must be addresses as part of the proposal.

Species selection and planting layout for vegetated WSUD assets is to preferably be undertaken by a suitably qualified Landscape Architect / Designer. Where a Landscape Architect / Designer's services are not used, the suggested planting species provided in Table 3-U are to be utilised.

Table 3-U – Suggested plant species

Context	Minimum number of plant species
Small scale urban	For bioretention filter area <50m^2 one of the following species: • Shara™ Lomandra fluviatilis • Evergreen Baby™ Lomandra labill
	For bioretention filter area 50-100m^2: One to two species from the list provided in Appendix I
	For bioretention filter area >100m^2: In the order of three to four species from the list provided in Appendix I
Medium – Large scale urban	In the order of four to six species from the list provided in Appendix I
Bushland	In consultation with the City

3.14.5 WSUD ownership transfer and bonding

WSUD asset and associated land may be either dedicated to the City or owned and managed by a private party. The latter may include Strata title subdivision with a community title lot that incorporates the WSUD asset and public roadworks.

Proposals to dedicate WSUD assets and associated land to the City are to be resolved at the Development Application Stage and must satisfy the requirements of the City's Dedication of Land Policy.

WSUD assets can be owned by a body corporate, property owner or other private party. Privately owned WSUD assets are to be maintained by the property owners in accordance with the approved operation and maintenance plans.

WSUD measures fulfilling a private functionality on a development site (e.g. those without public roads or associated stormwater drainage discharging to such measures) will not be recognised as a public asset to City of Coffs Harbour.

The following process for asset transfer and bonding is largely based on Transferring ownership of vegetated stormwater assets by Water by Design, 2012.

3.14.5.1 *Bioretention systems and other vegetated stormwater assets*

The following relates specifically to the transfer of bioretention systems as they make up the majority of WSUD assets. It also provides a general guide for other vegetated stormwater assets. Any departures from this process would be assessed on merit as part of the development application.

For the case of a bioretention unit serving multiple subdivision stages, the following criteria relate to ultimate development of all contributing stages.

Specific requirements relating to the following process are to be addressed at the Civil Works certificate stage.

Subdivision construction stage:

- Construct 'essential' elements of bioretention system and operate as a sedimentation basin until: 80% of subdivision is developed or for 4 years whichever comes first (relating to all

contributing stages to the system). 'Essential' elements can be negotiated at Civil Works Certificate stage (i.e. construct the earthworks, profiling and hydraulic structures but it may include or exclude the drainage layers and media).

- Provide a maintenance bond for the 'essential' elements of the bioretention system in accordance Part 1.7.
- Provide a stormwater asset bond for the landscaping and the uncompleted components of the bioretention system. The stormwater asset bond will be 150% of the total cost of construction, establishment and maintenance of the landscaping and 150% of the cost of construction of the uncompleted civil components. Maintenance requirements will be based on the approved Operation and Maintenance schedule.

Post subdivision construction

When 80% of allotment-building phase is complete or after 4 years following Practical Completion of the subdivision (whichever comes first):

- Remove allotment-building phase sediment protective measures from the bioretention system (where relevant);
- Install / construct any uncompleted works; and
- Mulch, plant and establish the bioretention system vegetation.

Practical completion inspection of the landscaping and the remaining components of the bioretention system will be undertaken once the above three items are complete , and vegetation must be established for a period of 24 months during which the vegetation has experienced active growth and development.

Off maintenance or final compliance inspection for asset transfer will be undertaken 12 months after practical completion of the landscaping.

For staged subdivisions, any temporary measures (e.g. sedimentation basins) must have the space and ability to be converted to a permanent measure (e.g. bio-retention basin). This ensures that for rare cases where indefinite postponement or funding delays occur between stages, the design can still achieve the objectives and requirements of this Technical Guideline.

Off maintenance or final compliance inspection for asset transfer will be undertaken 12 months after practical completion of the landscaping.

3.14.5.2 *Proprietary Systems*

The following provides an indicative process for the use of proprietary systems (e.g.. cartridge filter systems):

Subdivision Construction stage:

- For subdivisions: cartridge filters are not to be installed until 80% of allotment-building phase is complete or for 4 years following Practical Completion of the subdivision whichever comes first (relating to all contributing stages of the system);
- Civil components that form part of the proprietary system (chambers and pipes) may be constructed during the above stages and either operate as part of a sediment capture system or kept off-line;
- Provide maintenance bond for the constructed components; and
- Provide stormwater asset bond for the uncompleted components (e.g.. cartridge filters). The stormwater asset bond will be 120% of the cost of supply, installation/construction of the uncompleted components.

Post-Construction stage:

Practical completion inspection for a subdivision system will be undertaken once all the following items are achieved:

- 80% of subdivision is developed or after 4 years following Practical Completion of the subdivision (whichever comes first);
- Allotment-building phase sediment protective measures have been removed from the proprietary system (where relevant); and
- Installation / construction of any uncompleted works.

Off maintenance or final compliance inspection will be undertaken 12 months after Practical Completion.

3.14.5.3 *Private WSUD assets*

The maintenance responsibility shall be confirmed at development application stage, for WSUD assets that remain in private ownership, the following process is to be followed:

- During the construction stage, protection of the system is to be undertaken as described above for assets transferred to the City;
- Prior to the issue of an Occupation Certificate or Subdivision Certificate, a certificate from a suitably qualified inspector is to be issued to the Principal Certifying Authority to the effect that the system has been installed and complies with the approved design;
- For greenfield residential subdivisions, the use of individual on-site WSUD measures to achieve the pollutant reduction targets is not an acceptable stormwater management approach. This solution is deemed unsatisfactory because there are no reliable mechanisms to guarantee the long-term operation, protection, and maintenance of these systems in perpetuity;
- WSUD measures must not be shared by multiple properties unless subdivisions are designed to have common areas (e.g. common property as part of a Strata Plan, Community lot as part of a Community Title subdivision) and the shared WSUD measures are to be located within this area;
- When a centralised bio-retention basin is required to act as a sedimentation basin (as described in the previous section). The developer must detail the timing of works within the Operation and Maintenance Plan, which is required to be submitted with the updated stormwater management plan at Construction/Civil Works Certificate stage. In addition, this will need to be incorporated into the Community Management Statement (or equivalent) prior to Subdivision Certificate. This will include triggers, timing and when the City will receive confirmation of conversion works;
- In the scenario where a private WSUD system is accepted (e.g. Infill subdivision), the developer shall maintain all devices until a significant proportion (e.g. 80%) of the dwelling construction stage is complete. The eventual lot owner shall be required to maintain these (upon handover from the developer) to the satisfaction of the City. A plan of required operation and maintenance procedures for WSUD devices shall be supplied with the design documentation, and included in any community management statement (where applicable); and
- In some instances, the City may require the developer to submit an uncompleted works bond agreement for the remaining components (e.g. planting, filter media) of the private system. This is to ensure the measures are protected during dwelling construction stage.

To ensure on-going future maintenance of WSUD elements applicants may be required to create a "Positive Covenant" and "Restriction on the Use of Land" under Section 88B/88E of the Conveyancing Act 1919, prior to Occupation Certificate or Subdivision Certificate, burdening the property with the

requirement to maintain the WSUD elements in accordance with the approved operation and maintenance plan. For example, when the maintenance is carried out by a body corporate (or equivalent), the requirements are to include:

- A plan displaying the locations of the individual system components
- Manufacturer's product information sheets for all proprietary devices
- Clear indication of where the inspection and monitoring points are on the plan
- A schedule for regular inspection, maintenance, and monitoring of the devices

An example of the consent conditions the City may impose for a centralised system on a Community Title subdivision is below, it will involve relative agreements over the common lot, burdening the maintenance arrangements and repair on the owner, with the City as the authority benefited;

Example Conditions of Consent

DA-XX: Stormwater and Drainage Works Design (Subdivision)

Design plans of the stormwater drainage systems and treatment measures within the proposed subdivision, prepared by a qualified practicing Civil Engineer and in accordance with the requirements of the City, shall be submitted to and approved by the Certifying Authority before issue of a Subdivision Works Certificate.

A plan of any required interallotment drainage and easements to facilitate this drainage is to be approved by the City. Design details are to include consideration of the impact of concentration of stormwater on receiving land parcels.

The design is to achieve where applicable, compliance with the Coffs Harbour City Council Water Sensitive Urban Design Policy Targets. Design details are to include calculations showing the effect of the proposed development on design stormwater run-off flow rates and the efficiency of proposed measures to limit the flows.

(1) The bio-retention basin(s) are to be constructed as a sediment basin, until 80% of the building allotment phase is complete, or after 4 years following practical completion of the subdivision (whichever occurs first)

(2) The design shall be accompanied by an Operation and Maintenance Plan for the system. This is to include details of (but not limited):

a. Establishment period
b. Maintenance activities and frequency (including rectification works)
c. Timing of conversion works (including details on filter media testing)
d. Compliance inspections and checklists
e. On-going monitoring procedures

In this example, a Community Management Statement will be conditioned prior to the realise of Subdivision Certificate, as this links to the approved operation and maintenance plan. The City can take compliance action if the systems aren't maintained in accordance with their legal requirements. Noting that it is illegal for a property owner to not maintain their privately owned WSUD system, if it's deemed to be causing environmental harm.

Example Conditions of Consent

DA-XX: Community Management Statement (Stormwater)

Prior to the release of a Subdivision Certificate the proponent must submit and have approved a clause in the Community Management Statement for the maintenance regime and testing of the

stormwater treatment device for the common property. The Community Management Statement must include (but not limited to):

(1) Timing of any installation/construction of any uncompleted (including planting), with evidence of in-situ saturated hydraulic conductivity testing of filter media to demonstrate compliance with the approved design.

(2) Details of when a certificate from a suitably qualified inspector will be issued to the Principal Certifying Authority to the effect that the system has been installed and complies with the approved design (including Works-as-Executed plans)

(3) On-going monitoring and maintenance schedule in accordance with the approved Operation and Maintenance Plan

Example Conditions of Consent:

For private Torrens Title subdivision, an example of the Positive Covenant over each lot, with the City as the authority benefited is below. Terms:

a. The property owner must ensure there is appropriate water quality infrastructure to ensure that the treated water meets the requirements the City's Water Sensitive Urban Design Guidelines.

b. The property owner must ensure maintenance arrangements are in place for the regular maintenance and repair of the Water Sensitive Urban Design infrastructure installed on the property.

3.14.6 Development application and construction requirements

Table 3-V provides a list of the information required by the City at the various stages of development

Table 3-V – Information required by the City

Stage	Information required / matters to be resolved	
Development Application (DA)	Concept WSUD/stormwater management plan	☑
	Dedication of WSUD assets and associated land to the City (where applicable)	☑
	MUSIC modelling in electronic format[1]. For staged developments provide the results of the entire project and individual stages as separate data	☑
	Proprietary devices: sufficient detail to demonstrate suitability and effectiveness	☑
Civil Works Certificate	Stormwater Management Plan – details	☑
	Revised MUSIC model in electronic format if the proposal has changed from the DA stage[1]	☑
	Landscape plan which identifies any WSUD specific planting	☑
	Proprietary devices – technical specifications, proprietary operation and maintenance manuals and sufficient detail supporting devices efficacy claims	☑

	Operation and maintenance plan for each component of the system	☑
	Strata / Community title (draft) plans where required reflecting the operation and maintenance plan	☑
Building Certificate	Inspection compliance certificate for WSUD system	☑
During and afterConstruction	Certification of bioretention filter media specifications (comply with FAWB) – supply a min of 14 days prior to installation	☑
	In-situ saturated hydraulic conductivity testing (by independent test and certified)	☑
	WAE plans and operation and maintenance plan if amended	☑

[1] Not applicable for deemed to comply solution

Minimum requirements are to be generally in accordance with Appendix A and B of this Technical Guideline. In addition, Appendix C provides a WSUD checklist to be supplied with a Development Application. Note that Appendix C is complementary to the Technical Guideline and does not override the requirement to comply with Appendix A and B (where applicable).

3.14.7 Operation and establishment

Construction and establishment of vegetated WSUD assets (e.g. bioretention basins) should follow the protocols in Water by Design's Construction and Establishment Guidelines: Swales, Bioretention Systems and Wetlands (2010) or any superseding guidelines.

During construction, regular site inspections are to be undertaken, to ensure the device is built according to the design intent. If any changes to the design intent or requirements arise after development approval, it is essential to consult with the relevant City officers for guidance before proceeding.

Suggested guidelines for the development of operation and maintenance plans for vegetated WSUD assets:

- Water by Design's Maintaining Vegetated Stormwater Assets (2012); and
- Adoption Guidelines for Stormwater Biofiltration Systems (Payne et al, 2015).

Rectification of a damaged WSUD asset is to be undertaken in accordance with Water By Design's Rectifying Vegetated Stormwater Assets (2012). Healthy Waters Ltd, Brisbane. A checklist for developers on what information is required for the Off-maintenance final compliance inspection is located in Appendix G and a checklist for developers on what information is required for the on-maintenance final compliance inspection is located in Appendix H.

3.14.8 WSUD Elements and Design Requirements

WSUD elements are to be strategically arranged for maximum effectiveness and are classified as primary, secondary, or tertiary based on the size of the contaminants they target. The 'treatment train' removes a variety of sediments, pollutants, and nutrients from stormwater before discharging it into receiving catchments. A general overview is highlighted below:

Primary Treatment (screens gross pollutants, targets litter and coarse sediment, necessary for the effective operation of secondary and tertiary treatment systems)

- Gross pollutant capture devices
- Sediment basins and/or forebays

Secondary Treatment (targets sediments and finer particles, can be used to manage stormwater quality and quantity, but won't meet water quality objectives in isolation)

- Grass/vegetated swales

Tertiary Treatment (targets nutrients, bacteria, fine sediment, and heavy metal removal from stormwater; essential for meeting water quality objectives)

- Bioretention systems
- Constructed wetlands

3.14.8.1 *3.14.8.1 Gross Pollutant Traps (GPT)*

Gross Pollutant Traps (GPT) are designed to remove large solid pollutants (e.g. plastic bags, bottles, and debris larger than 5 millimetres) sediments and oils from stormwater runoff. GPTs are often installed using chambers, weirs, screens, baskets, or baffles. GPTs are vital for enhancing water quality and protecting aquatic environments by preventing coarse sediments and contaminants from entering water systems.

GPTs can be provided both above and below ground, with different devices remove different amounts of gross pollutants, total suspended solids (TSS), total phosphorus (TP), total nitrogen (TN) and/or hydrocarbons. Some examples of the types of GPTs currently found with the City of Coffs Harbour are below:

- Trash Racks;
- Release and Screen Nets;
- Grill/Grates;
- Direct screening devices;
- Inline Filtration devices;
- Pit Baskets;
- Continuous Deflective Separation (CDS) devices;
- Silt Arrestor; and
- Hydrodynamic Separators.

GPTs are to be designed and constructed so that:

- The GPT is located in an accessible location;
- The GPT is not located near electrical equipment; and
- The GPT can be fitted with a suitably designed lockable access cover approved by the City that prevent entry of unauthorised persons.

These devices vary greatly, though in general GPT's should be designed to capture gross pollutants and coarse sediment from 4EY to 1EY events. The inlet to the GPT shall be designed to bypass flows which exceed 1EY [or 63.21% Annual Exceedance Probability (AEP)]. The design should ensure that there is no increased risk of flooding upstream of the GPT or on adjoining properties.

The City of Coffs Harbour does not currently have an endorsed manufacturer or supplier for GPT's. While there are numerous manufactured devices and technical design manuals available, details of

the chosen product will need to be provided with a Development Application, and subject to City approval.

Other requirements:

- When located upstream of a vegetated asset (e.g. Bio-retention basin) the invert of the GPT is to be set, at a minimum, to the top of the extended detention depth (typically 300mm above the filter media) and in an accessible location for maintenance purposes;
- Where GPT's are incorporated into the road reserve, the carriageway must be widened to allow for a parking bay to safely facilitate cleaning and maintenance procedures required by the City. Where off-street access is required, the maintenance track is to be designed to be accessible by a Medium Rigid Vehicle (MRV) in accordance with the requirements of AS2890; and
- Gross pollutant traps should be strategically installed in industrial and commercial areas where there is a high potential for litter generation.

Regular maintenance is crucial for their effectiveness, The frequency of maintenance is determined by the location and the volume of debris and sediment entering the trap. GPT suppliers can provide information on maintenance methods typical to their product, however normally cleanouts are required around once every 3-6 months, or after major storm events, with each trap being monitored during the first few years of operation to determine the required cleanout frequency. Poorly maintained GPTs can:

- Fail to trap pollutants;
- Release contaminants by leaching from the collected pollutants; and
- Reduce the capacity of the drainage system and potentially lead to upstream flooding.

Development integrating such systems on private development will warrant a Positive Covenant to registered on the title of the property, to ensure future owners/occupants are aware of the system and maintenance requirements.

3.14.8.2 *3.14.8.2 Bio-retention basins*

Bioretention basins function by filtering stormwater runoff through densely planted vegetation, allowing the water to percolate through a filter media. As the water percolates, pollutants are captured through fine filtration, absorption, and some biological uptake. Bioretention basins are highly effective at treating pollutants from runoff associated with impervious surfaces, such as roads, parking lots, and roofs, before this runoff enters sensitive receiving waters.

The system comprises an extended detention storage, filter media, drainage layer(s), plants and underdrainage. These systems are highly versatile and can be implemented at various shapes and scales. Bio-retention basins are vulnerable to clogging and on-going maintenance is vital, therefore it is important to implement appropriate upstream protection, such as a sediment basin, forebay or other primary treatment methods (e.g. a gross pollutant trap). Bioretention basins must be flat and not on a slope.

Bio-retention basins are often designed to treat runoff from 1EY to 4EY storm events (previously referred to as 3-month Average Recurrence Interval). In the City of Coffs Harbour, the recommended storm event for water quality treatment design is 1EY or 63.21% Annual Exceedance Probability (AEP).

Further design guidance can be obtained in the Bioretention Technical Design Guidelines (Version 1.1, 2014, Water by Design) and adoption guidelines for stormwater biofiltration systems by the Cooperative Research Centre for Water Sensitive Cities (CRC WSC, 2015).

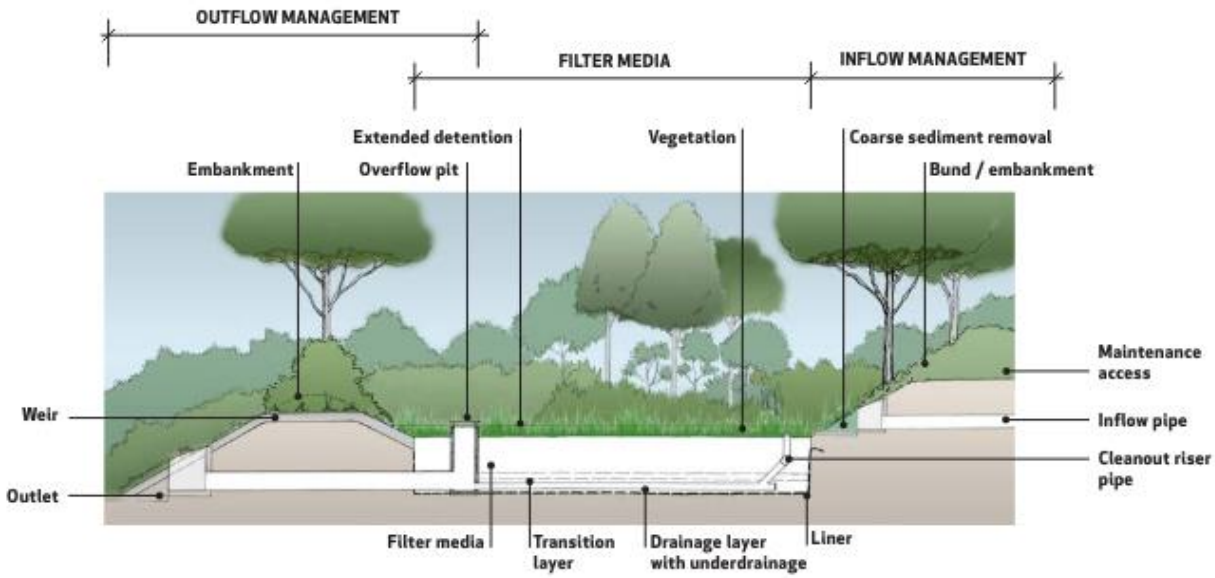

Figure 6 – Components of a typical bio-retention system

Drainage Profile

Drainage Profile refers to the design of filter media, transition layers, underdrainage, and hydraulic structures to facilitate the discharge of treated water from the system. The two common types of bio-retention drainage profiles utilised at the City of Coffs Harbour are a **"**Saturated" and "Conventional" system (referred to as Type 1 and 3 respectively in Water By Design Bioretention Technical Design Guidelines Version 1.1).

Saturated Systems

Saturated bio-retention basins are designed by maintaining a permanent water storage zone within the basin. This saturated zone can allow the vegetation to access water during dry periods, enhance nutrient removal, and facilitates plant growth. They have an subsoil drainage and an outlet structure which holds water at a defined level within the transition and drainage layer.

Saturated systems are to be generally in accordance with IPWEA standard drawing DS 070.

Conventional Systems

Conventional bio-retention systems encourage infiltrations into the surrounding soils, and have slotted or perforated underdrain pipes for drainage when the infiltration capacity of the soil is exceeded. The Conventional system is generally in accordance with IPWEA standard drawing DS-073. an overview of the drainage profile is as follows:

- a permeable geotextile liner around their sides (no liner along the base);
- a transition layer that is at least 100 mm deep;
- a drainage layer that is at least 300 mm deep with a slotted or perforated pipe that has at least 50 mm aggregate above it and at least 150 mm aggregate below it; and
- a flat base under the drainage layer.

Geotextile fabrics, whether permeable or non-permeable, are not to be installed between the various soil layers within the bioretention system profile. The direct contact between soil layers is essential for maintaining optimal hydraulic connectivity and plant root development throughout the system.

Filter media

The filter media layer is the primary component responsible for pollutant removal in bioretention systems. It achieves this through two main mechanisms:

- Fine filtration of stormwater as it percolates through the media; and
- Supporting vegetation growth.

The vegetation plays several crucial roles:

- Enhances the filtration process;
- Maintains the porosity of the filter media; and
- Absorbs some nutrients and other pollutants from stormwater.

The depth of the filter media is critical and must be sufficient to support healthy plant growth. The overall recommended depth ranges between 500-1000 mm depending on site conditions, however the typical minimum depth is as follows:

- Minimum for shrubs/grasses/sedges: 400 mm; and
- Minimum depth for trees: 800 mm.

The greater depth for trees is necessary to prevent root systems from interfering with the underlying perforated drainage pipes. These depth requirements ensure optimal performance of both the filtration process and the vegetation component of the bioretention system.

The filter media specifications are in accordance with the Facility for Advancing Water Biofiltration Guidelines (FAWB) (2009), and are shown on City Standard Drawing SD-250-01 and Table 3-W.

Table 3-W – Filter media specifications

Function	Portion by Weight (%)	Portion size (mm)
Clay & Silt	2-6%	(<0.05 mm)
Very Fine Sand	5-30%	(0.05-0.15 mm)
Fine Sand	10-30%	(0.15-0.25 mm)
Medium to Coarse Sand	40-60%	(0.25-1.0 mm)
Coarse Sand	7-10%	(1.0-2.0 mm)
Fine Gravel	<3%	(2.0-3.4 mm)

The following specifications are based on results of extensive treatment performance testing conducted by FAWB as well as recommendations made by AS4419 – 2003 (Soils for Landscaping and Garden Use). Filter media must be tested for the following; media that do not meet these specifications should be rejected or amended:

i. Total Nitrogen (TN) Content – <1000 mg/kg.

ii. Orthophosphate (PO43-) Content – <80 mg/kg. Soils with total phosphorus concentrations >100 mg/kg should be tested for potential leaching. Where plants with moderate phosphorus sensitivity are to be used, total phosphorus concentrations should be <20 mg/kg.

iii. Organic Matter Content – at least 3% (w/w). An organic content lower than 3% is likely to have too low a water holding capacity to support healthy plant growth. In order to comply with both this and the TN and PO43- content requirements, a low nutrient organic matter will be required.

iv. pH – as specified for 'natural soils and soil blends' 5.5 – 7.5 (pH 1:5 in water).

v. Electrical Conductivity (EC) – as specified for 'natural soils and soil blends' <1.2 dS/m.

Saturated Hydraulic Conductivity

The saturated hydraulic conductivity (Ksat) of bio-retention basin filter media should be within 100 to 300 mm/hr to support the long-term growth of bio-retention plants. In the City of Coffs Harbour, values above 300 mm/hr hinder plant establishment and survival due to insufficient water retention. The Facility for Advancing Water Biofiltration Guidelines (FAWB) (2009) similarly recommend a range of 100 to 300 mm/hr.

The saturated hydraulic conductivity is to be tested and documented prior to handover to the City. The infiltration test is to be in accordance with *Adoption Guidelines for Stormwater Biofiltration Systems (CRC, 2015) Appendix I: Measurement of hydraulic conductivity – Using in situ and ex situ (laboratory) sampling methods*. A copy of this document can be found at the following link: https://watersensitivecities.org.au/content/stormwater-biofilter-design/

The number of tests required to be provided are specified in Table 3-X.

Table 3-X – Number of In-Situ Hydraulic Conductivity Tests Required

Bioretention Filter Area (m^2)	Number of In-Situ Hydraulic Conductivity Tests Required
1-50	2
51-100	3
101-200	4
201+	5 + 1 extra test point per 100m^2 or part thereof

Transition layer

A coarse sand layer, acting as a 'bridging' layer, placed beneath the filter media to prevent finer particles from migrating into the drainage layer. This transition layer should not restrict the flow rate through the filter media and must be 100mm deep. The only exception is when a saturated system is chosen, where the top water level in the saturated zone must be stored within this layer, and 100mm below the filter media. This zone can be adjusted to meet site requirements and must be at least 350mm deep, as depicted in IPWEA DS 071.

The transition layer material must be a clean, well-graded sand containing less than 2% fines with grading requirements are to be in accordance with SD-250-01. To avoid migration of the filter media into the transition layer, the particle size distribution of the sand should be assessed to ensure it meets the following bridging criteria that is:

- D15 (transition layer) ≤ 5 × D85 (filter media) where:
  D15 (transition layer) is the 15th percentile particle size in the transition layer material (i.e.,

15% of the sand is smaller than D mm), and D85 (filter media) is the 85th percentile particle size in the filter media.

Drainage layer

The drainage layer collects the stormwater at the bottom of the system and conveys it via underdrainage pipes. Drainage material is to comprise of fine gravel 2 – 5mm with less than 2% fines. The profile is to be in accordance with Table 3-Y. The drainage layer gravel must meet the following bridging criteria:

- D15 (drainage layer) ≤ 5 x D85 (transition layer).

Table 3-Y –Drainage Profile requirements

Bio-retention drainage profile type	Drainage layer parameters
Saturated Zone (Type 1)	• Minimum 150mm deep • ≥ 50 mm of drainage layer material above all slotted or perforated underdrainage pipes. • Base does not need to slope.
Conventional (Type 3)	• Minimum 300mm deep • ≥ 50 mm of drainage layer material above all slotted or perforated underdrainage pipes. • ≥ 150 mm of the drainage layer material is below the slotted or perforated pipes. • Base does not need to slope.

Mulch

Mulching is an important part of the establishment process. The preference is for organic friable mulches that degrade quickly, within six months, such as fine sugar cane mulch. The mulch thickness should be limited to 50—75 mm to ensure new vegetation shoots are not hindered. The mulch should be kept clear of plant stems by approximately 50 mm. Generally, synthetic weed mat, geotextile or filter fabrics, wood chip (due to floatation) and hydro-mulch or equivalent which hinders infiltration is not supported. See City Standard Drawing SD250-01 for more information.

Extended Detention Depth Zone

The extended detention depth zone is defined as the vertical distance between the surface of the filter media and the overflow pit in a bioretention basin. When stormwater enters the basin, it temporarily ponds in this zone, which serves to regulate flow velocities across the filter media surface and enhances the overall treatment capacity of the system.

The standard extended detention depth is 300 mm. However, this depth can be adjusted by ±100 mm based on specific site conditions (e.g. streetscape bio-retention systems), with an absolute minimum depth of 200 mm. It is important to note that depths exceeding 400 mm can negatively impact plant health, increase the risk of filter media clogging, and ultimately reduce the performance of the bioretention basin.

Maximum Water Levels and integration with Detention Storage

The City of Coffs Harbour recommends using the 1EY storm event, equivalent to a 63.21% Annual Exceedance Probability (AEP), for water quality treatment design. In addition, the system must be designed to safely convey flows in accordance with the requirements of the downstream network. This design consideration is crucial to prevent adverse nuisance drainage issues on adjoining properties.

The maximum depth of inundation is 400mm above the overflow pit crest (e.g. maximum depth of 800mm in total). At this point in time the emergency overflow weir is to be activated. However, when detention storage is to be incorporated into the bio-retention basin (for all events up the 1% AEP) the City may accept an absolute maximum level of 1.2m (e.g. 400mm deeper). In this scenario, calculations and justification are provided which clearly demonstrates the relatively short duration of inundation (e.g. hours), and the depths experienced above the standard 400mm will be infrequent. Physical barriers such as dense plantings or fencing may be required to prevent access to the area and these details are to be included with the concept designs.

It is to be noted that the extended detention volume, which is designed to enhance pollutant removal in the bioretention system, should not be included in calculations for the overall detention volume necessary to achieve water quantity objectives. These two volumes serve distinct purposes and should be considered separately in the stormwater management design process.

Within regards to a streetscape bio-retention basin, the maximum water level is dictated by the allowable flow depth in the adjacent street kerb and gutter.

Overflow and emergency spillway

All bioretention systems require an emergency overflow. This feature is crucial for preventing erosion and scour within the biofilter during high-intensity rainfall events. While these systems are typically designed to engage the spillway during major storm events, it's important to note that blockages need to be accounted for in the design. Such blockages can lead to more frequent activation of the overflow mechanism than initially anticipated in the design.

Emergency overflow details are shown on IPWEA standard drawing WSUD-006, Spillways require structural design certification and are to be in accordance with the subsequent sections of this Technical Guideline.

Inlet pipe and Inflows

The inlet pipe to the system is to be at least 100mm above the surface of the bioretention basin to prevent siltation or debris accumulation in pipes (refer Section 3.4.2.1 in Water By Design Bioretention Technical Design Guidelines). Where a sediment forebay is required, an additional minimum 100mm set down is required from headwall to sediment forebay.

Inlet inflows to the bio-retention system will require some form of energy dissipation or scour protection to ensure that concentrated flow does not damage the filter media or vegetated batters.

Inflows

For concentrated surface or pipe inflow, energy dissipation and scour protection at the inflow point or sediment forebay is designed to prevent flows from damaging the bio-retention system. A sediment forebay, or Gross Pollutant Trap is required if the catchment is greater than 2ha. If a sediment forebay is present it will provide some protection, however a rock protection pad is required downstream of the forebay area. Details are shown on City Standard Drawing 200 series.

Where the pipe inflow velocity exceeds 3 m/s, energy dissipation rock or concrete structures are required upstream of the sediment forebay and shall be designed in accordance with QUDM.

Upstream pre-treatment requirements

Coarse sediment removal measures are to be implemented upstream of the bioretention basin in accordance with Table 3-Z.

Table 3-Z –Coarse sediment removal methods

Catchment scenario	Coarse sediment removal methods
Roof runoff only	None
Catchment < 2 ha	None*
Catchment > 2 ha and < 5 ha	Vegetated swale, coarse sediment forebay, inlet pond or gross pollutant trap
Catchment > 5 ha	Inlet pond or Gross Pollutant Trap

*Sediment accumulation at the point of inflow should be regularly assessed and accumulated sediment cleared if it is blocking inlet or it is impeding infiltration. Source: Table 13 Water By Design Bioretention Technical Design Guidelines Version 1.1.

Sediment forebay design

Sediment forebay design is to be in accordance with IPWEA standard drawing WSUD-005 or City Standard Drawing XX. However, advice on sizing is below:

$V_s = A_c \times R \times L_o \times F_c$

Where:

- V_s = volume of forebay sediment storage required (m^3)
- A_c = contributing catchment area (ha)
- R = capture efficiency (0.8 recommended)
- L_o = sediment loading rate (m^3/ha/year) [if local data unavailable, adopt 0.6m^3/ha/y]
- F_c= desired cleanout frequency (years) [adopt 1 cleanout per year]

The preliminary depth of the sediment forebay can be found by dividing the minimum volume by the minimum area using the following (Note that sediment forebays should not be more than 300mm deep).

$$D_s = \frac{V_s}{A_f}$$

D_s = forebay depth (<0.3m)

V_s = minimum forebay volume (m^3)

A_f = minimum forebay area (m^2)

To allow the forebay to drain freely, 50mm wide vertical slots are to be provided at 2m intervals around the forebay area. Sediment forebays within the bioretention basin are not to be modelled in MUSIC for any pollutant removal.

Outlet pipe level for water quality treatment devices

Bio-retention outlets are to drain freely to the receiving waterway and be situated where accumulated sediment does not block the outlet pipe. Table 3-L in Section 3.7.3.4 provides detail of the minimum invert of the outlet in relation to the receiving drainage system.

Wet Season Groundwater or tidal levels

Allowing groundwater or tidal water to enter the bio-retention layers can be harmful to the biota (plants, bacteria, fungi, etc.) within the system. Plants may suffer due to poor water quality or prolonged root saturation.

Table 3-AA provides a summary of the specifications for different drainage profile types based on their level relative to wet season groundwater level (WSGL) and the highest astronomical tide (HAT).

Table 3-AA –Location of bio-retention in relation to WSGL and HAT

Drainage profile Type	Level relative to wet season groundwater level (WSGL)	Level relative to the highest astronomical tide (HAT)
Type 1 Saturated Zone	Impermeable liner extends ≥ 300 mm above WSGL	Impermeable liner extends ≥ 300 mm above HAT
Type 3 Conventional	Base of underdrainage pipes ≥ 300 mm above WSGL	Base of transition layer ≥ 300 mm above HAT

Source: Table 7 of Water By Design Bio-retention Technical Design Guidelines Version 1.1.

Underdrainage

Typically a 100-150mm slotted pipe (HDPE, UPVC or similar) or ag-pipe can be used for under-drainage. When designing and installed, the following specifications shall be considered:

- ø100-150mm sub-soil lines should not be wrapped in a filter sock (or equivalent) due to risk of clogging (refer to Water By Design Bioretention Technical Design Guidelines – section 3.5.1.2);
- The slots in the pipe shall not allow the drainage layer aggregate to freely enter the pipe (under-drainage with slot width of 2 mm or smaller is preferred);
- The maximum spacing of under-drains for bio-retention systems <100 m^2 is 1.5 m from centre to centre. For bioretention systems >100 m^2 the maximum spacing can be increased to 2.0 - 2.5 m;
- The under-drains shall be sloped towards the outlet pit (min. 0.5% longitudinal grade) and the base of filtration trench shall be free from localised depressions; and
- Flush-out/clean-out riser points are to be installed at the end of each subsurface drainage at a maximum of 30m intervals. These must extend vertically at least 150 mm above the surface of the filter media for inspection and maintenance purposes. The vertical section of the underdrain must be non-perforated and capped to prevent short-circuiting flows. Caps should be secured with screws to minimize the risk of vandalism. All connections should use Y-connections to facilitate easy access and cleaning.

Access for Construction and Maintenance

Suitable access tracks need to be provided to the system in accordance with the following:

- Minimum embankment track width of 4 metres for excavator during construction period;
- The width of the bioretention basin is a maximum of 10 metres wide to facilitate excavator reach (Maximum 15m if accessible from all side). All parts of the basin need to be reachable by excavator;
- Minimum 2.5m width trafficable path for maintenance purposes upon completion, with a min 0.5m either side of trafficable path (Minimum 3.5m in total);
- To be designed to be accessible by a Medium Rigid Vehicle (MRV) in accordance with the requirements of AS2890;
- The design is to ensure safe vehicular access to the bio-retention basin is possible post-storm event for rectification and clean-out procedures;
- Bollards and fencing are required for the access to ensure no vehicles can casually enter the bio-retention basin maintenance track; and
- Reference should be made to Figure 34 of the Bioretention Technical Design Guidelines (Water by Design, 2014).

Other design criteria

- Maximum batter slope for the City of Coffs Harbour is 4H:1V or flatter for bio-retention basins;
- Bioretention basins should be designed without walls where feasible, as walls can present safety hazards. In the instance where a wall is approved with the design, it must comply with Section 3.3.5.5 and Figure 33 of Water By Design Bioretention Technical Design Guidelines Version 1.1 (2014). Retaining walls will require engineer's certification if they meet the criteria provided in Section 7.5 of this Technical Guideline; and
- Bio-retention basins (both public and private) are to be located in a position to provide appropriate solar access to the system to ensure plant survival (e.g. cannot be located under roof structures).

Operation and Maintenance

An operation and maintenance schedule is to be prepared for any bioretention basin (Public or private). Notwithstanding, regular watering of bioretention basin vegetation is essential for successful establishment and healthy growth. The frequency of watering to achieve successful plant establishment is dependent upon rainfall, maturity of planting stock and the water holding capacity of the soil. General plant maintenance to planting at the bio-retention basin shall include the establishment of a maintenance regime to reduce plant failure/death. This shall include (but not limited to):

- Week 1 - 6: 5 waterings/ week;
- Week 7 - 12: 3 waterings/ week;
- Week 13 - 18: 2 waterings/ week;
- If there is no rain, each plant should receive 2.5 - 5.0 litres of water per week during the first six weeks;

- After an initial 4-month period, watering may still be required, particularly during dry periods. Watering requirements for healthy vegetation can be determined by ongoing inspections;
- That plants are not subjected to insect attack or disease;
- That plant guards are not suffocating growing plants; and
- That newly established plants are at a competitive advantage against invasive weeds species. Any dead seedlings must be replaced with the same species and plant replacement must be in sufficient time to allow for all plant establishment prior to the end of the maintenance period.

Ongoing weed control of planted works to the bio-retention basin shall include:

- Implementation of a methodical and thorough weed management program including fortnightly inspections during plant establishment (a minimum of four months). Removing any weeds by hand; and
- Weed management must be undertaken by a suitably qualified and licensed personnel experience in weed identification and management and herbicide usage. Where possible, the use of herbicides during secondary weed control should be minimised.

Ongoing maintenance of bioretention basin by strata management (or other):

- Water plants as required during dry periods. Watering requirements for healthy vegetation can be determined by ongoing inspections;
- Replace any sick or dead plants with the same species;
- Bio-retention basin to be kept free of weeds and periodic trimming of plants as required. Remove any weeds by hand;
- Flush clean-out riser and subsoil drains annually;
- Inspect and clean pits and trash screens 6-monthly and after large rainfall events;
- where a sediment forebay is adopted, removal of accumulated sediment;
- All trash, clippings and weeds are to be removed from the bio-retention area and disposed of in the relevant bins;
- Any scouring of the bio-retention basin surface shall be repaired and affected plants reinstated; and
- Removal of sediment where it is smothering the bioretention basin vegetation.

Location of Bio-retention Basins within the Floodplain

Bioretention basins should be located outside the 1% Annual Exceedance Probability (AEP) flood extent to avoid being destroyed during such event. However, if this cannot be achieved, the following key design requirements will be imposed:

- The Flood Impact and Risk Assessment (FIRA) must include an analysis of the bioretention footprint to ensure the bioretention basin does not adversely impact flood levels and velocities for the 1% AEP flood event. This assessment should demonstrate no increase in flood levels in adjacent properties or impact hydraulic conveyance of the 1% AEP flood by blocking or diverting flows;

- In addition, Bioretention basins are to be situated outside of the existing floodway or flood conveyances areas;
- Velocities on the embankments during the 1% AEP event are to be <1.0m/s. Erosion and scour protection measures are to be incorporated into the design. Jute-matting will be required in some instances;
- Protection between the 1% AEP mainstream flood level and the bioretention basin overflow level to be provided;
- The upper surface of the filter media should be positioned above the 20% Annual Exceedance Probability (AEP) mainstream flood level of the receiving waterway. In situations where this elevation requirement cannot be met, it is necessary to conduct additional hydraulic modelling for a range of flood events, (20% AEP up to the 1% AEP). This extended analysis aims to verify that the tailwater levels of the bioretention system and the receiving waterway do not coincide, which could potentially compromise the system's performance and effectiveness. The tailwater levels are to be generally in accordance with Table 3.7.3.3; and
- Vegetation species within the bioretention basin must be able to withstand periodic inundation from floodwater.

Integrating within regional detention basins or the Public Realm

The placement of WSUD measures within the 1% AEP flood extent is discouraged. At the discretion of the City of Coffs Harbour, where bio-retention basins or stormwater quality measures are incorporated into the floodplain as part of a holistic project or precinct scale design for the catchment (Such as public realm, regional open space and mainstream detention basins). Discussion is to be had with the City at strategic/masterplan stages. The design will need to include (but not limited to)

- Installation of a pre-treatment forebay or Gross Pollutant Trap upstream of the bioretention basin component to capture coarse sediments and debris;
- A bypass structure is to be implemented for low flows to be treated via the bioretention as per the previous sections. The high flow bypass will be directed to the detention basin. The bioretention component is to be situated higher than the detention component to not have a detrimental impact on maintenance intervals; and
- The maximum allowable depth is still only as per the maximum water levels specified within this section.

3.14.8.3 Vegetated swales and Bio-swales

The difference between a normal swale and a bioretention swale (Bio-swale) is that the latter has filter media and underdrainage. Bioretention swales are very similar to bio-retention basins but they that integrate both treatment and conveyance capabilities.

- The bioretention component provides treatment, filtering out finer particles and dissolved pollutants. It can be designed to occupy either a portion or the entire length of the swale.
- The swale component pre-treats stormwater by removing coarse to medium sediments.
- The treated stormwater is collected at the base of the system via underdrainage, to the downstream drainage network or waterway.

Stormwater can be directed into these systems through various means, including:

- Direct surface runoff (e.g via flush kerbs, or kerb breakouts). They can receive lateral flows across grassed or vegetated batters (1 in 4 or flatter).
- Discharge from piped drainage systems.

Table 3-BB –Minimum design requirements for Bio-swales

Design element	Design requirement
Longitudinal Slope	1% to 4%
Base Width	0.5-2 metres
Geometry	Trapezoidal
Batter Slopes	4(H):1(V) or flatter
Drainage Profile	Depths of filter media, transition, and drainage layers are to be in accordance with the bio-retention details within this section
Filter Media	The saturated hydraulic conductivity (Ksat) filter media should be within 100 to 300 mm/hr Filter media should be hydraulic conductivity tested before construction and before handover.
Extended Detention Depth	Maximum 300mm
Flow Velocity	It is important to ensure that velocities are maintained sufficiently low to avoid scouring of bioretention filter media and vegetation. • Maximum 0.5 m/s for minor events (50% to 10% AEP) • Maximum 1.5 m/s for major events up to 1% AEP A maximum velocity-depth product of 0.4m^2/s is required to ensure public safety.
Underdrainage	The preference is for Ø 100 pipes Flush points are to be provided at upstream ends and at maximum 30m intervals (if necessary)
Planting	As per Appendix I
Other	• Bioretention swales, which have a bed slope of 0% are not permitted. • All swales are to be designed so that they do not require fencing • Bollards can be utilised at maximum 4m internal in the road reserve to discourage the parking of vehicles on the swale • Mannings ‘n’ values should be based on the type and density of the vegetation

	Safe intersection sight distances and pedestrian movement along the road verge must not be impeded
MUSIC modelling	As per the guidance in Water by Design (2018) MUSIC Modelling Guidelines (Consultation Draft) and any corresponding updates.

Both vegetated swales and bio-retention swales can be incorporated into the public road reserve (either roadside or median). A 40-50mm drop down from the surface of the edge restraint to the top of the landscaping is to be provided to prevent any vegetated material moving onto the road surface. A buffer between the road edge and the vegetated swale is recommended.

Vegetated Swales

Similar to the Bio-retention swale, the vegetated swales are open, plant-covered channels that offer an alternative to traditional stormwater systems, such as kerbs, channels, and underground pipes along roadways. Swales can be used as pre-treatment for larger water quality measures (e.g. Bio-retention basin) and they distribute and slow down surface water flows through interaction with vegetation. Swales should be situated to prevent overflow towards existing or future infrastructure including any neighbouring properties.

Benefits of vegetated swales include dual functionality as both source and conveyance controls and integration into streetscape. The design criteria is similar to that of a bio-retention swale and is highlighted below in Table 3-AA

Table 3-CC –Minimum design requirements for vegetated swales

Design element	Design requirement
Longitudinal Slope	Ideally 1% to 4% For slopes steeper than 4%, check dams or banks along swales can help to distribute flows and reduce velocities* Lower than 1% swales can become waterlogged and/or have stagnant pooling
Base Width	0.5-2 metres
Geometry	Trapezoidal
Batter Slopes	4(H):1(V) or flatter
Extended Detention Depth	Maximum 300mm
Flow Velocity	It is important to ensure that velocities are maintained sufficiently low to avoid scouring of bioretention filter media and vegetation. • Maximum 0.5 m/s for minor events (50% to 10% AEP) • Maximum 1.5 m/s for major events up to 1% AEP A maximum velocity-depth product of 0.4m^2/s is required to ensure public safety.
Planting	As per Appendix I

Other	• Swales, which have a bed slope of 0% are not permitted. • All swales are to be designed so that they do not require fencing • Bollards can be utilised at maximum 4m internal in the road reserve. • Mannings 'n' values should be based on the type and density of the vegetation Safe intersection sight distances and pedestrian movement along the road verge must not be impeded
MUSIC modelling	As per the guidance in Water by Design (2018) MUSIC Modelling Guidelines (Consultation Draft) and any corresponding updates.

* For steep slopes, details of how erosion risk to the swales will be managed and details of construction staging requirements to reduce erosion risk whilst the swale is unvegetated is required.

Infiltration systems

Infiltration systems are uncommon in the City of Coffs Harbour, infiltration systems are used where stormwater discharge is to a natural system and groundwater recharge and maintaining pre-development runoff volume is required. The purpose of infiltration systems in a stormwater management strategy is as a quantity measure, not as a water quality measure. Stormwater quality design objectives in this chapter shall be achieved prior to stormwater entering any infiltration device.

They are highly dependent on local soil characteristics and are best suited to sandy soils with deep groundwater to allow infiltration. For areas with lower permeability soils, these measures can still be applied, but larger areas for infiltration and increased detention storage volumes are necessary to accommodate the slower exfiltration rate from the system's base. Geotechnical engineering advice which shows the capacity for the soils to discharge water without detrimental effect to other properties is required to accompany a development application.

Additionally, sufficient setback distances from structures are required for infiltration measures to prevent structural damage due to soil wetting and drying. If there is a potential for high groundwater, this will need to be investigated further through a geotechnical report. Any infiltration measure will need meet the requirements outlined in Section 3.10.

Wetlands

Constructed wetland systems are shallow, heavily vegetated water bodies designed to remove pollutants through enhanced sedimentation, fine filtration, and pollutant uptake processes. Wetlands are highly effective in treating large volumes of stormwater runoff, and they also enhance local amenities and provide habitat diversity.

Prior to submitting a Development Application involving the use of a wetland, the Proponent is to engage in preliminary discussions with relevant City Officers. During these consultations, the applicant should be prepared to demonstrate that a constructed wetland is the most appropriate and effective stormwater treatment measure for both the site and the intended Asset owner.

Access to constructed wetlands requires special considerations and should be provided in accordance with Section 3.6 of the Wetland Technical Design Guidelines (Water by Design, 2017). For

more information, please see Wetland Technical Design Guidelines (Healthy Land and Water, 2017); and the Wetland Design Manual (Melbourne Water, 2017).

Proprietary systems

Proprietary WSUD systems (such as cartridge devices) will be assessed by the City on a case by case basis. While the City of Coffs Harbour believes this approach allows for flexibility in assessing the suitability of different devices, demonstration that the application of vegetated stormwater treatment measures (e.g bio-retention) is not practicable will be required. Such devices will need to be accompanied by an operation and maintenance plan, and detailed design drawings. The typical arrangement of these systems is a number of cartridges containing the engineered filter media located in an underground vault.

For proprietary devices, verified water quality performance reports must accompany the stormwater management plan, clearly demonstrating that the proposed measures achieve the pollutant reductions specified in the MUSIC model node. Performance modelling of these devices should align with the claims verified through the Stormwater Quality Improvement Device Evaluation Protocol (Stormwater Australia, 2018).

Where proprietary devices are approved, assurance Developments incorporating such systems will require relevant conditions and a Positive Covenant to be registered on the property title, ensuring future owners and occupants are informed about the system and its maintenance requirements. This is to ensure the pollutant removal performance remains throughout the lifespan of the development.

Green Roofs

Roof surfaces that are partially or fully covered with vegetation are known as green roofs. They have a series of layers including a vegetated layer, filter medium, drainage, root barrier and a waterproof membrane. Some of the benefits are:

- Enhanced biodiversity
- Improve the quality of water before it enters waterways
- Manage the quantity of stormwater, including harvesting and re-use
- Reducing the urban heat island effect

For development proposals consisting of primarily roof area (minimum 90%), for example, multi-storey residential apartment buildings, the City of Coffs Harbour may consider the installation of a Green Roof (covering minimum 30% of the roof) as an alternative, in order to achieve the WSUD objectives outlined in Section 3.14.2.1 of this Technical Guideline. Design considerations for a development application are to include cross sections which show:

- The location of the proposed structures;
- Drainage, irrigation and waterproofing;
- Overflow provisions;
- Proposed growing medium (type, depth);
- Plant species; and
- Safety features.

If approved, all waterproof membranes must be tested for leakage during construction and certification from the installer must be provided prior to Occupation Certificate.

Further guidance on the design and modelling can be found in the following documents Inner West Council: Green Walls, Roofs and Facades Technical Guidelines (2020) and Blacktown City Council WSUD developer handbook MUSIC modelling and design guide (2020).

3.15 APPENDIX A – Information to be shown on drawings – stormwater drainage

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
1)	**General**			
a)	Cover sheet with locality plan and list of drawings and their revision number			
b)	Plans prepared in A1 format at a scale of 1:500			
c)	Drawing scale is shown on drawings as a bar scale			
d)	Scale of detail drawings is shown as appropriate			
e)	Schedule of symbols			
f)	Benchmark within 100 metres of development site is shown			
g)	North point shown			
h)	Site topography is shown via contour lines			
i)	Each plan to be numbered with revision no. and revision schedule and revision date, with a cloud around revisions with a revision no.			
2)	**Drainage layout plans**			
a)	Catchment area plan including sub-catchments and areas is submitted			
b)	Existing services and drainage structures are shown			
c)	Lot boundaries and numbers shown			
d)	Pipeline or table drains are numbered			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
e)	Pipeline or table drain centreline chainages are shown			
f)	Pipeline diameters or table drain cross-sections are shown			
g)	Kerb or table drain profiles are clearly nominated			
h)	Location and associated numbering of pits shown			
i)	Type and size of pits clearly indicated			
j)	Location and dimensions of any proposed easements or drainage reserves is shown			
k)	Location of minor and major system overland flow path shown			
l)	Natural drainage paths are shown			
m)	Location of natural watercourse to be drained to is identified			
n)	Location of any retention, detention or water quality devices is shown			
3)	**Drainage longitudinal sections**			
a)	Longitudinal sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
b)	Longitudinal section shows the following;			
i)	Chainages			
ii)	Pit number, inlet type			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
iii)	RL of existing surface at each inlet structure, outlet structure, pit and/or change of grade			
iv)	Design RL of all inlet and outlet structures; pit, pipe and table drain inverts, pit inlets and all changes of grade			
v)	Design grades including length of each gradient			
vi)	Pipe diameters and classes and/or table drain capacities is shown.			
vii)	Hydraulic Grade Line analysis results as per AR&R			
viii)	Location of existing and proposed services and utilities			
4)	**Open channel drainage cross sections**			
a)	Cross sections are drawn at scale of 1:100 natural			
b)	Cross sections show the following at no more than 20 metre intervals and at all intermediate changes of grade or profile;			
i)	Chainages			
ii)	RL of existing surface			
iii)	Design RL of open channel invert and top of batters			
iv)	Batter slopes of open channels are shown			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
v)	Section profiles of all open channels is shown			
vi)	Details of low-flow pipes and/or lined inverts is shown			
vii)	Details of Sub-Soil Drainage (if required)			
c)	Sections of pits including details of access covers and access provisions is shown			
d)	Scour protection details shown			
e)	5% and 1% AEP flood levels			
5)	**Miscellaneous**			
a)	Location and details of any Water Quality devices is shown			
b)	Location and details of any batter catch-drains			
c)	Details of the type of vegetation to be used on batters			
d)	Scour protection to all outlet structures is shown			
6)	**Basins**			
a)	Contours shown			
b)	Grades of batters			
c)	Depth indicated with spot levels			
d)	Basin elevation / volume relationship at 100mm intervals			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
e)	Surface area tabulated (where applicable)			
f)	Crest width			
g)	Low level outlet details			
h)	Scour protection			
i)	Signage – depth markers, warning signs,			
j)	Safety in design report			
k)	Batter slopes, depth and typical section of any retention/detention structures is shown			
l)	Spillway capacity – Q100			
m)	5% and 1% AEP flood levels			

3.16 APPENDIX B – Checklists - stormwater drainage

Item No.	Description	Reference	Developer confirmation	City confirmation	Comments
1	Stormwater servicing strategy including catchment areas and flow paths	3.4.3			
2	Hydrological modelling, including details of start-up parameters used in computer modelling	3.6.3			
3	Hydrological design sheets used for sub-area discharge calculations	3.6.1			
4	Hydraulic design sheet used for calculating major system flows	3.8.1			
5	V x D hazard classification and criteria	3.8.2			
6	Width of flow in gutters between pits does not exceed 2.5m	3.7.1.1			
7	Volume of flow in K&G does not exceed 20l/s and/or width of flow does not exceed 1m at upstream tangent points of curves/kerb returns	3.7.1.1			
8	Required vertical drops across pits have been achieved;	3.7.2.1			
9	Tailwater levels have been included and the effects have been accounted for	3.7.3.3			
10	Bypass from any pit on grade does not exceed 15% of the total flow at the pit	3.7.1.1			

11	Hydraulic design sheet used for pipeline design and HGL analysis	3.7.2.1			
12	Culvert design calculations	3.7.3.7			
13	Details of modelling or calculations used for trunk drainage system design	3.5.6.2			
14	Hydrological/hydraulic assessment and design of retention/detention structures	3.11			
15	Risk analysis for retention/detention structures	3.11.3.2			
16	Geotechnical report for proposed retention/detention structures	3.11.4			
17	Landscape plan for retention/detention structures	3.11.3.13			
18	Details of proposed OSD systems	3.12			
19	Hydrological/hydraulic assessment and design of OSD systems	3.12.1.3			
20	Maintenance plan for OSD systems	3.12.1.7			
21	All pipe sizes in the model correspond with pipe sizes in your plan set				
22	Safety in design report	1.5.2			
23	Structural certification for all non-standard structures				

3.17 APPENDIX C – Water Sensitive Urban Design (WSUD) checklist for development applications

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
1)	**Conceptual stormwater plan**			
a)	Site area (m^2)			
b)	Conceptual drainage arrangement with invert levels (metres AHD)			
c)	Development layout with clear breakdown of contributing catchments (e.g. Roof area, driveway, pavement, landscape, and space available for stormwater treatment)			
d)	Existing and proposed ground levels (metres AHD) including any earthworks			
e)	Location of WSUD measures (e.g. Bio-retention, Proprietary products)			
f)	Cross and Long sections of measures, including inflow/outflow pipework with levels			
g)	Location of detention storage (if applicable)			
h)	Legal point of discharge location, including level(s) of receiving drainage structure and/or waterway			
i)	Demonstration of no conflict with existing infrastructure (e.g. water, sewer)			
j)	Clearly highlight what sizing approach has been used (Deemed to Comply or MUSIC modelling)			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
2)	**Deemed To Comply Solution** (if Applicable)			
a)	Solution ID (e.g. R6, R7)			
b)	Rainwater tanks with sizing (kL per dwelling) and location shown (see relevant ID for more information)			
c)	Overflow from rainwater tanks directed to stormwater treatment measures (required with Deemed-to-comply solutions)			
d)	Bio-retention Filter media area (m^2) [1.3% or 1.8% of catchment area]			
e)	Total footprint (m^2)			
3)	**MUSIC** (If Applicable)			
a)	Model Schematic, clearly showing breakdown of sub-catchments, and a treatment train which matches with Stormwater Plan			
b)	Summary of MUSIC results demonstrating compliance with the pollutant reduction targets.			
c)	MUSIC-Link output to be provided showing compliance, and evidence of using Coffs Harbour Mereological templates.			
4)	**Bio-retention Basin** (If Applicable)			
a)	Filter media area shown (m2)			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
b)	Total Footprint (m2), this includes relevant design requirements including batters, high flow bypass, sediment forebay etc.			
c)	Profile with layers clearly showing depths (e.g. Filter Media, Transition Layer and Drainage layer) being in accordance with contemporary guidelines.			
d)	Filter media specification and grading in accordance with Facility for Advancing Water Bio-filtration (FAWB) Guidelines			
e)	Extended Detention Zone and Overflow Pit (e.g. Surface ponding for water quality purposes, 200-300mm typical)			
f)	Maximum water level (if utilised as detention storage for Water Quantity purposes)			
g)	Emergency Overflow weir or embankment levels shown			
h)	Plant Species and Density (as per Table 2 and Appendix A)			
i)	Access arrangements			
j)	Scour and erosion protection			
k)	Establishment and Maintenance Notes			
5)	**Other Stormwater Quality Improvement Devices (e.g. Gross Pollutant Traps, Proprietary Filter products)**			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
a)	Standard Drawings with relevant Invert Levels			
b)	Technical Manual and/or verification from Manufacturer			
c)	Modelling to support application			
d)	Operation and Maintenance Plan			

3.18 APPENDIX D – Stormwater design data for input into DRAINS

PIT / NODE DETAILS

Name	Type	Family	Size	Ponding	Pressure	Surface	Max Pond	Base	Blocking	x	y	Bolt-down	id
				Volume (cu.m)	Change Coeff. Ku	Elev (m)	Depth (m)	Inflow (cu.m/s)	Factor			lid	
Name	*OnGrade or Sag*							0				No	

DETENTION BASIN DETAILS

Name	Elev	Surf. Area	Not Used	Outlet Type	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Length(m)	id
Name															

SUB-CATCHMENT DETAILS

Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp
	Node	Area (ha)	Area %	Area %	Area %	Time (min)	Time (min)	Time (min)
Catchment Name	*Pit name*							

PIPE
DETAILS

Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg	Rl	Chg	RL	etc
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)	(m)	(m)
Name	*Pit name*	*Pit name*					Concrete					1							

CHANNEL
DETAILS

Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Width	L.B. Slope	R.B. Slope	Manning	Depth	Roofed
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)	
Name	*Node Name*	*Node Name*	*Prismatic*										no

OVERFLOW ROUTE
DETAILS

Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth	SafeDepth	Safe	Bed	D/S Area		id	U/S IL	D/S IL	Length (m)
			Time	Level	Length	Coeff. C	Section	Major Storms	Minor Storms	DxV	Slope	Contributing					
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%					

Overflow Name	*Pit name*	*Pit name*					*Descrip*										

3.19 APPENDIX E - Flood compatible building guidelines

Flooding is a natural hazard that can result in significant financial, environmental, and social costs. While ideally buildings should be located to avoid flood prone land, this is not always feasible. Where buildings are located within flood prone land, it may be requirement to design and construct using materials and methods that are structurally compatible with flood water to a defined flood level. This guideline specifies materials and construction methods which would be considered acceptable to be less likely to be prone to water damage.

The City of Coffs Harbour DCP 2015 (DCP) provides additional controls for building in flood prone areas. If you are lodging a development application you will need to comply with the DCP.

Table 3-DD provides a summary of the building materials that are considered compatible with flood water.

Table 3-DD –Suitable flood compatible building material

Building Component	Suitable flood compatible building material	Unsuitable building material
Flooring and Subfloor Structure	• Masonary piers/columns • Masonary Walls • Galvanised steel piers/columns • Reinforced concrete slab • Suspended timber floor Marine grade plywood	• Timber piers • Particle board flooring • Standard grade plywood • Engineered timber products (unless certified by manufacturer as being resilient to effects of repeated immersion)
Floor Covering	• clay tiles • concrete, precast or in situ • concrete tiles • epoxy, formed-in place • mastic flooring, formed-in-place • rubber sheets or tiles with chemical-set adhesives • silicone floors formed in-place • vinyl sheets or tiles with chemical-set adhesive • ceramic tiles, fixed with mortar or chemical-set adhesive • asphalt tiles, fixed with water resistant adhesive • Terrazzo	• Loose fit nylon or acrylic carpet (closed cell rubber underlay) • Wall to wall carpet • Wall to wall seagrass matting • Cork • Linoleum
Walls	• reinforced concrete or mass concrete • Cavity brick walls • Face brick or blockwork • Galvanised steel frames or sheets • Aluminium Frames • Stainless Steel Frames • Glass and Glass blocks	• Timber frames in areas that are subject to force from fast flowing water • Brick/block veneer with venting (stud frame) • Particle board • Fibreboard or strawboard • Wallpaper • Cloth wall coverings

	• plastic sheeting or wall with waterproof adhesives • fibro-cement board • brick, face or glazed • clay tile glazed in waterproof mortar • concrete • concrete block • steel with waterproof applications • stone, natural solid or veneer, waterproof grout • Cement render • Ceramic wall tiles	• Standard plywood • Gypsum plaster • Plasterboard • Exterior grade plywood • Solid wood with allowance for swelling • Hardboard • Exterior grade particleboard
Roofing Structure (for situations where the relevant flood level is above the Ceiling)	• reinforced concrete construction • galvanised metal construction • Timber trusses with galvanised connections	• Traditional timber roof frame construction • Inaccessible flat roofs • Non-galvanised structural steelwork or connections • Unsecured roof tiles
Doors	• solid panel with waterproof adhesive • flush door with marine ply filled with closed cell foam • painted metal construction • aluminium or galvanised steel frame • Timber frame, fully epoxy sealed before assembly • Flush or single panel marine ply with waterproof adhesive	• Standard timber frame • Standard flush hollow core with PVA adhesive and honeycomb paper core
Insulation	• Foam (closed cell types) • Sprayed Polyurethane foam	
Windows	• Aluminium frame with stainless steel rollers or similar corrosion and water resistant material • Timber frame, fully epoxy sealed before assembly with stainless steel or brass fittings	• Timber with PVA glues • Mild steel fittings • Large windows low to the ground
Nails, Bolts, Hinges and Fittings	• brass, nylon, galvanised steel or stainless steel • removable pin hinges • hot dipped galvanised steel wire nails or similar	Mild steel

The location of electrical services, heating and air conditioning systems, and water tanks need to be carefully considered when designing a development on flood prone land

Table 3-EE –Design considerations that minimise damage to services from inundation

Electrical and Mechanical Equipment	Electrical and mechanical materials, equipment and installation should conform to the following requirements Main Power Supply – Subject to the approval of the relevant authority the incoming main commercial power service equipment, including all metering equipment, shall be located above the relevant flood level. Means shall be available to easily disconnect the dwelling from the main power supply Wiring- All wiring, power outlets, switches etc. should to the maximum extent possible, be located above the relevant flood level. All electrical wiring installed below the relevant flood level should be suitable for continuous submergence in water and should contain no fibrous components. Earth core linkage systems (or safety switches) are to be installed. Only submersible-type splices should be used below the relevant flood level. All conduits located below the relevant flood level should be so installed that they will be self-draining if subjected to flooding. Equipment – All equipment installed blow the relevant flood levels should be capable of disconnection by a single plug and socket assembly Reconnection – Should any electrical device and/or part of the wiring be flooded it should be thoroughly cleaned and checked by an approved electrical contractor before reconnection
Heating and Air Conditioning Systems	Heating and air conditioning system should, to the maximum extent possible be installed in areas and spaces of the house above the relevant flood level. When this is not feasible every precaution should be taken to minimise the damage caused by submersion according to the following guideline; Fuel – Heating systems using gas or oil as fuel should have a manually operated valve located in the fuel supply line to enable fuel cut-off Installation – The heating equipment and fuel storage tanked should be mounted on and securely anchored to a foundation pad of sufficient mass to overcome buoyancy and prevent movement that could damage the fuel supply line. All storage tanks should be vented to an elevation of 600mm above the relevant flood level Ducting – All ductwork located below the relevant flood level should be provided with openings for drainage and cleaning. Self-draining may be achieved by constructing the ductwork on a suitable grade. Where ductwork must pass through a water-tight wall or floor below the relevant flood level, the ductwork should be protected by a closure assembly operated from above the relevant flood level
Water Tanks	Locate the inlet of the tank as high as possible Elevate above ground tanks and hot water heaters and ensure supporting structures are flood resistant. Use corrosion resistant material Ensure tanks are securely fastened to prevent flotation

3.20 APPENDIX F – Guideline to preparing flood impact and risk assessments

3.20.1 Introduction

This document aims to provide technical guidance on the preparation of Flood Impact and Risk Assessment (FIRA) that may be required for development within the City of Coffs Harbour.

The aim of a Flood Impact and Risk Assessments is to support applications to identify and substantiate the following:

- That the development will not adversely impact upstream or downstream flood levels or behaviour to the detriment to any other property;
- The impact and risk of flooding on the development and its intended use;
- How impacts can be managed to minimise risk to life and property and; and
- Define flood behaviour and constraints where information is not available.

Flood impact and risk assessments must be prepared by a suitably qualified engineer, with experience and advanced skills in catchment hydrology, floodplain hydraulics and a good working knowledge of Floodplain Risk Management practices and guidance in New South Wales.

Flood Studies and Floodplain Risk Management Studies and Plans endorsed by the City should also be considered by any Flood Impact and Risk Assessment where the information for this study is deemed suitable. It is expected that any flood modelling undertaken is consistent with the methodology and results from studies endorsed by the City. Where an endorsed Flood Study is deemed suitable, the City recommends that these models are used (refer to the City's fees and charges to purchase the City's flood models).

3.20.2 Guidelines and reference documents

Flood impact and risk assessments should be consistent with the principles and guidance provided in;

- Flood Risk Management Guideline LU01 – Flood Impact and Risk Assessment (NSW Government , 2023)
- Australian Institute of Disaster Resilience (AIDR) Handbook Series, Handbook 7;
- Australian Rainfall & Runoff (ARR 2019 and specific project reports);
- Australian Building Codes Board (ACBC) Construction of Buildings in Flood Hazard Areas);
- Guideline on modelling the interaction of catchment flood and oceanic inundation in coastal waterways;
- Practical Consideration of Climate Change; and
- Revised 2016 Design Rainfalls – Further Improvement of Local Techniques for Coffs Harbour (WMAwater, 2022). https://coffs-data.arr-software.org/

3.20.3 Scope and Requirements of the flood impact and risk assessments

The scope and requirements of flood impact and risk assessments may vary depending on a number of factors which may include the scale, type and location of the proposed development, and whether a City endorsed flood study exists that contains information required to support the application.

The City may request a simplified or detailed flood impact and risk assessment depending on the nature of the proposed development and associated flood risk.

3.20.4 Simplified flood impact and risk assessment

A simplified flood impact and risk assessment can usually be considered for small scale development within the 1% AEP flood extent, or as a preliminary assessment for larger scale development located within the flood fringe.

Small scale development include the following:

- Single residential dwellings;
- Dual occupancies;
- Alterations and additions to residential development; and
- Small alteration and additions to Commercial and industrial development.

These assessments are usually required to determine relevant management measures as per the related development controls within Coffs Harbour DCP 2015 and should consider the type of development and related flood constraints on the land. Consideration may be given to the use of an existing City endorsed flood study if it contains sufficient local detail. If existing flood studies do contain sufficient information, the simplified assessment can be undertaken using a cross-sectional analysis of pre and post development cross-sections, and flows based on flood information from the existing flood studies to assess any impacts.

If this information is not suitable or available, the assessment may employ simplified techniques or modelling to establish a level of understanding of existing flood behaviour and potential impacts of the proposed development that is commensurate to the scale of development or potential flood impacts.

A detailed flood impact and risk assessment may also be required if the simplified assessment shows a potentially significant impact on flood behaviour or risk to the development.

3.20.5 Detailed flood impact and risk assessment

Detailed flood impact and risk assessments are usually required for large scale development within the 1% AEP flood extent, or near waterways and drainage paths where no existing, or suitable flood information exists . Large scale development includes;

- Changes to Coffs Harbour LEP 2013 (e.g. change of Land Zoning) to enable more intensive development where the land subject to the increased development potential is a minimum of 5,000m^2 in area;
- Subdivision of land to create more than 3 resulting lots;
- Residential development comprising of 3 or more dwellings; and
- Large commercial and/or industrial development.

Detailed flood impact and risk assessments should be fit for purpose and consider the relevant guidelines and reference documents listed above. Generally, it is expected that these assessments utilise a 2 dimensional flood model to assess the impacts of the development on flood behaviour and the risks to the development. Where a suitable City endorsed flood model exists, it is preferred that the flood impact and risk assessment utilises this model and its methodologies to assess the development proposal.

3.20.6 Hydrological and hydraulic modelling

Hydrologic and Hydraulic models developed for the Flood Impact and Risk Assessment, should be consistent with the latest ARR methodologies, and local techniques for design rainfall estimation where applicable. Where sufficient historical information is available, the hydrological and hydraulic model shall be calibrated and verified.

Hydrological models using ARR2016 IFDs in catchments covered by “Revised 2016 Design Rainfalls – Further Improvement of Local Techniques for Coffs Harbour” (WMAwater, 2022) should use the design rainfalls from this report.
https://coffs-data.arr-software.org/

If a City endorsed flood model is used, validation of the model results is required.

Modelled design flood event at a minimum shall include the 5% AEP, 1% AEP and Probable Maximum Flood to assess the full range of flooding. An assessment of the impacts of climate change will also be required for some types of development. Additional design may be required depending on the development.

3.20.7 Blockages

The flood model developed for the Flood Impact and Risk Assessment must consider blockages of bridges, culverts and other stormwater conduits if applicable. The blockage assessment should be consistent with Book 6, Chapter 6, of Australian Rainfall and Runoff.

For the design of new structures, blockage factors are to be used as part of their calculations.

For the design of detention basin volume, weirs, and low flow outlets should be sized assuming no blockage. Basin spillways shall be sized assuming the relevant blockage factors.

The following blockage assessment form may be used: https://arr.ga.gov.au/arr-guideline/revision-projects/revision-project-reports/data/blockage-assessment-form

3.20.8 Modelling of Buildings

Proposed and existing building should be modelled consistent with any suitable endorsed City Flood Study. If there is no existing or suitable flood study, buildings should be represented by;

- Removal of the building footprint from the model; or
- Increase in elevation of the building footprint.

Representing existing or proposed buildings on piers using layered flow constrictions in TUFLOW is acceptable. The opening should be modelled with a 25% blockage.

3.20.9 Interaction of coastal and catchment flooding

If a suitable endorsed City Flood Study exists, the downstream boundary condition and ocean levels should be consistent with this study.

In catchments where no suitable flood study exists the assessment should be undertaken using the Guideline on modelling the interaction of catchment flood and oceanic inundation in coastal waterways.

3.20.10 Climate change

The impact of Climate change is required to consider sea level rise if the study area is within tidal limits and the increased intensity of rainfall.

Modelling of the 0.5% (1 in 200) or 0.2% (1 in 500) AEP event may be accepted as an indicator for rainfall intensity increases due to climate change where appropriate.

3.20.11 Flood impact criteria

While flood impacts are assessed using a merit based approach, the following is the City's expected baseline criteria;

- < 10mm increase in flood level on residential, commercial and industrial buildings in the 1% AEP design flood or less;
- < 20mm increase in flood level on residential, commercial and industrial land (outside of building envelopes);
- < 50mm of agricultural land in the 1% AEP design flood or less;
- < 250mm increase in flood level for open space areas (pasture, forest, recreation) in the 1% AEP design flood or less;
- < 500mm increase in flood level in the PMF;

- < 10 % increase in peak velocity in the 1% AEP for velocities over 2 m/s; and
- No change to flood immunity, hazard and time of inundation for affected roads or driveways.

3.20.12 Supporting information

A report should be submitted for the flood impact and risk assessment. The report should adequately document;

- The flood models used, updated or produced, the methodology adopted and assumptions used;
- Details of management measures to be implemented to minimise the impacts and risks (including advice on timing of management measures for staged developments);
- An assessment of the residual impacts of the development on and off site; and
- Any recommendations to support the development.

The following information should be included in the report to support the proposal;

- Catchment map and study area map including existing flood 1% AEP flood extent;
- Hydrological parametrisation, calculations and analysis;
- Plot of pre and post development hydrographs at key locations for the full range of events used in the hydraulic model;
- Tabulate comparisons of peak flows to any previous modelling;
- Map of 2D model domain, and details of grid size, and boundary conditions used in the Hydraulic model;
- Map of Pre and post developed roughness layers;
- Tabulate pre and post developed hydraulic structures and blockage factors applied;
- Map of validation to the existing Council flood model (if applicable);
- Map of pre and post development peak flood depths (1 % AEP only);
- Map of pre and post development peak flood level (m AHD) and chainages for long section (1 % AEP only);
- Map of pre and post development peak flood velocity including velocity vectors (1 % AEP only);
- Long section of waterway invert with peak flood level (m AHD) for pre and post development (all design events);
- Tabulate pre and post development peak flood level (m AHD) and differences at key locations (all design events);
- Map of pre and post development flood hazard (H1-H6 for all design events) and identify significant differences;
- Map of pre and post development flood function (all design events) and identify significant differences;
- Map of post development flood emergency response classification (1% AEP and PMF);
- Map of Impact of climate change on flooding;
- Plot of pre and post development output hydrographs at key locations (all design events);
- Flood level impact/difference maps (all design events);
- Velocity impact/difference maps (all design events); and
- Map of updated Flood Planning Area if there is expected to be a significant change.

Mapping of peak flood levels, depths, velocity, hazard and flood function should be supplied to the City in GIS format (ascii/rst, shapefiles, waterride formats are acceptable) to assist in the assessment. Model files including check files may also be requested.

Any required updates to the report should be provided as a report revision, with a section specifying the relevant changes.

3.21 APPENDIX G – Checklist – Off-maintenance / final compliance inspection

Checklist - Off-Maintenance / Final Compliance Inspection Bioretention systems			
Asset ID:			
Asset location:			
Constructed by:			
Date of inspection			
Inspectors	(Undertaken by City Engineering Inspectors and Open Space team)		
'On-maintenance' period:			
Pre-Site Inspection		**Y**	**N**
Defects Liability List fixed from On-Maintenance Inspection			
Operation and Maintenance Plan provided for the system			
Vegetation establishment period completed (2 growing seasons – 24 mths)			
Bioretention Basin Work-as-Executed Drawings and Planting Schedule documents provided (if amended from On-Maintenance Inspection)			
HOLD POINT			
Visual Inspection		**Y**	**N**
Visually looks OK and appears to be working as designed			
Sediment accumulation at inflow points			
Litter within system			
Erosion on banks, in filter media, around structures and outlets			
Traffic damage present?			
Inspect clean out points and flush - if required			
Clean-out points have secure caps			
Outlet pipe is free draining			
No sediment build-up in overflow pit or at pipe / weir outlets			
Evidence of overly long periods of ponding			
No major depressions in filter media			
Testing hydraulic conductivity of media. Use in-situ test* Note: 2 test points for filter media area up to 50m^2, 3 tests for area up to 100m^2. with an extra test point for every additional 100m^2 or part thereof. Conduct two constant head tests (50mm and 150mm) at each test point. Calculated hydraulic conductivity to be in the range of 100-300mm/hr and a copy of the documentation provided to the certifying authority. **Refer to Adoption Guidelines for Stormwater Biofiltration Systems Appendix I (CRC, 2015)*			
Plant survival satisfactory (minimum 90% survival) (if not, additional planting required and follow-up inspection in 6 months time – not before)			
Plant coverage satisfactory (minimum 90% cover) (if not, additional establishment time and/or additional planting required and follow-up inspection in 6 months time – not before)			
Plant health OK – free from disease / pests			
No weeds			

Comments / Corrective Actions

3.22 APPENDIX H – Checklist – On-maintenance for bioretention systems

Checklist - On-Maintenance Inspections Bioretention systems			
Asset ID:			
Asset location:			
Constructed by:			
Date of inspection			
Inspectors	(Undertaken by City Engineering Inspectors and Open Space team)		
Prior to Removal of Protective Covering		**Y**	**N**
Bioretention Basin Work-as-Executed Drawings and Planting Schedule documents provided. Proposed ongoing maintenance program provided.			
Contractor confirmed mulch, plants and additional filter media (for filling any local depressions) are ready to install after removing protective covering. Planting to commence within 1 week of removing protective covering.			
HOLD POINT			
Removal of Protective Covering and Testing Media		**Y**	**N**
Inspect removal of protective covering to ensure machinery does not drive onto filter media (to avoid compaction)			
No erosion on banks, in filter media, around structures and outlets			
Inspect clean out points and flush - if required			
Clean-out points have secure caps			
Outlet pipe is free draining			
No sediment build-up in overflow pit or at pipe / weir outlets			
Flatten the surface of the filter media using a spreader bar. The surface must be at the design level (± 25mm). Fill any local depressions with additional filter media. Care should be taken to not over-compact the filter media.			
Testing hydraulic conductivity of media. Use in-situ test* Note: 2 test points for filter media area up to 50m^2, 3 tests for area up to 100m^2. with an extra test point for every additional 100m^2 or part thereof. Conduct two constant head tests (50mm and 150mm) at each test point. Calculated hydraulic conductivity to be in the range of 100-300mm/hr and a copy of the documentation provided to the certifying authority. **Refer to Adoption Guidelines for Stormwater Biofiltration Systems Appendix I (CRC, 2015)*			
HOLD POINT -			
Planting of Bioretention Basin		**Y**	**N**
Correct mulch has been supplied (quickly degrading mulch eg sugar cane mulch)			
Mulch applied to correct depth and secured with jute mesh or other means			
Supplied plants are correct species			
Supplied plants are in correct pot sizes and maturity			
Plants have been installed at correct planting density			
Mulch is clear of plant stems by approximately 50 mm			
Work-as-Executed Drawings marked up with final plant species and densities			

Date of earliest Off-Maintenance Inspection	

Bio-retention Basin maintenance checklist				
Location				
Inspection frequency	3 to 6 monthly	Date of visit		
Location				
Description				
Site visit by				
INSPECTION ITEMS		Y	N	ACTION REQUIRED (DETAILS)
Litter accumulation?				
Litter within swales?				
Erosion at inlet or other key structures (eg crossovers)?				
Traffic damage present?				
Evidence of dumping (building waste, oils etc)?				
Vegetation condition satisfactory (density, weeds etc)?				
Littoral vegetation condition satisfactory (density, weeds etc)?				
Replanting required?				
Settling or erosion of bunds/batters present?				
Weed removal or mowing required?				
Damage/vandalism to structures present?				
Crossing structures free from damage?				
Drainage system inspected?				
COMMENTS				

Comments / Corrective Actions

3.23 APPENDIX I – Landscaping species for WSUD systems

Core functional bioretention plan species – WSUD plant species require the following features:

- They are able to tolerate short periods of inundation punctuated by longer dry periods. For bioretention systems, these dry periods may be reasonably severe due to the free draining nature (low water holding capacity) of bioretention filter media
- Generally have spreading rather than clumped growth form
- Perennial rather than annual
- Have deep fibrous root systems

Species name	Common Name	Type	Height (mm)	Comments
Groundcovers – bioretention systems				
Bacopa monnieri	bacopa	prostrate	100	Not suitable for sandy soils with low water holding capacity
Baumea teretifolia		tufted	300-1000	Not suitable for sandy soils with low water holding capacity
Carex appressa* #	Tall sedge	Groundcover – tufted	1000	Not suitable for sandy soil with low water holding capacity
Carex gaudichaudiana	Tufted sedge	tufted	600	Not suitable for sandy soils with low water holding capacity
Carex pumila	Coastal sedge	tufted	250	Salt tolerant
Cymbopogon refractus	Barbed wire grass	tufted	300	
Cynodon dactylon	couch	turf	50-150	Mowing required to achieve smaller heights
Cyperus polystachyos	Bunchy sedge	tufted	600	
Dianella caerulea	Blue flax lily	tufted	600	
Ficinia (Isolepsis) nodosa* #	Knobby club sedge	Groundcover – tufted sedge	600	Salt tolerant sandy conditions

Gahnia aspera	Saw sedge	tufted	1000	Not suitable for sandy soils with low water holding capacity
Gahnia sieberiana #	Red-fruit saw-sedge	Groundcover – tufted sedge	1500-3000	
Imperata cylindrica #	Blady grass	Groundcover – tufted grass	500	
Juncus amabilis*	South west NSW		500-1100	Grows in damp places
Juncus flavidus*	Mid west NSW		250-900	
Juncus kraussii	Sea rush	tufted	600-2300	Salt tolerant
Juncus usitatus	Common rush	tufted	500	Not suitable for sandy soils with low water holding capacity
Lepidosperma laterale #	Variable sword sedge	Groundcover – tufted sedge	500-1000	Shade tolerant
Lomandra confertifolia	Mat rush	tufted	400	Shade tolerant
Lomandra fluviatilis	Shara™	tufted	500	
Lomandra hystrix #	Green mat rush	Groundcover – tufted herb	1000	Shade tolerant - Not suitable for sandy soil with low water holding capacity
Lomandra labill.	Evergreen Baby™	tufted	400	
Lomandra longifolia #	Spiny headed mat rush	Groundcover – tufted herb	1000	Shade tolerant
Pennisetum alopecuroides #	Swamp foxtail grass West of range NSW	Groundcover – tufted grass	1000	Shade tolerant, this plant is not invasive
Poa labillardieri #	Common tussock grass	Groundcover – tufted grass	450	
Sporobolus virginicus	Marine couch	turf	To 400	Salt tolerant

Themeda australis #	Kangaroo grass	Groundcover – tufted grass	300-500	
Groundcovers – wetland system				
Baumea articulata	Jointed twig rush	Wetland DM / M	1000-2000 (6-8/m^2)	Slow growth plant solo
Baumea juncea	Bare twig rush	Wetland SM / T	300-1000 (8-10/m^2)	Slow establishment
Baumea rubiginosa	Soft twig rush	Wetland M / M	300-1000 (6-8/m^2)	Can be slow to establish
Carex appressa	Tall sedge	Wetland EM / M	500-1200 (4-8/m^2)	High surface area
Carex breviculmis	Short stem sedge	Wetland B / T	To 150 (6-8/m^2)	Very adaptable
Carex inversa	Knob sedge	Wetland EM / M	100-300 (8-10/m^2)	Rapid establishment
Carex pumila	Coastal sedge	Wetland B / T	100-250 (8-10/m^2)	Salt tolerant, drought tolerant
Ficinia nodosa (Isolepsis nodosa)	Knobby club rush	Wetland SM / M	500-1500 (6-8/m^2)	
Gahnia clarkei	Tall saw sedge	Wetland B / T	1500-2500 (4-6/m^2)	Plant solo
Gahnia siberiana	Red fruited saw sedge	Wetland B / T	1500-3000 (4-6/m^2)	Aesthetic
Juncus usitatus	Common rush	Wetland SM / M	300-1200 (8-10/m^2)	Rapid growth

Lepidosperma laterale	Variable sword sedge	Wetland EM / M	400-900 (6-8/m^2)	Shade tolerant
Lomandra filiformis	Wattle mat rush	Wetland B / T	150-500 (6-8/m^2)	Shade tolerant when established
Lomandra longifolia	Spiny headed mat rush	Wetland B / T	500-1000 (4-6/m^2)	Shade tolerant
Small tree / shrub – bioretention systems				
Breynia oblongifolia	False coffee bush	shrub	1-2	
Callistemon salignus	White bottlebrush	tree	2-15	Full sun to semi shade
Callistemon sieberi #	River bottlebrush	shrub	3-10	Requires moist conditions during establishment but tolerates dry periods once established
Banksia robur #	Swamp banksia Kempsey - wollongong	small tree	1-1.5	Moist soils on coastal sand and peat soils
Elaeocarpus obovatus	Hard quandong	tree	5-30	
Goodenia ovate*	Hoop goodenia South east NSW	Shrub	2	
Hardenbergia violacea	Purple coral pea	shrub	1-3	Scrambling or prostrate, full sun to light shade
Jacksonia scoparia	dogwood	shrub	1-3	Sunny position
Leptospermum liversidgei #	Olive tea tree	shrub	1-3	Moist soil sunny position
Leptospermum polygalifolium	Wild may	Shrub	1-4	Sunny position
Lomatia silafolia	Crinkle bush	shrub	1-2	Partial sun or shade

Melaleuca ericifolia*	Swamp paperbark South from Hastings river	Shrub / small tree	Up to 8	
Melaleuca linariifolia #	Flax-leaved paperbark	Small tree	5-10	adaptable over a wide range of climates and will tolerate less than perfect drainage. In nature it is often found in areas which suffer periodic inundation**
Melaleuca viridiflora #	Broad leaved tea tree Northern tropical australia	Small tree	3-10	adaptable to a wide range of soils and conditions but does particularly well on heavy clays which are waterlogged in the wet.**
Large Tree				
Casuarina cunninghamiana #	River she oak	Tree	10-35	
Casuarina glauca #	Swamp oak	Tree		
Lophestemon confertus	Brush box	tree	10-30	
Lophostemon suaveolens #	Swamp mahogany	Tree	5-25	Sunny position
Melaleuca bracteata #	Black tea tree North from macleay river	Tree	5-15	Sunny position
Melaleuca nodosa	Prickly leafed paperbark	tree	2-7	Sunny position
Melaleuca quinquenervia #	Broad leaved paperbark	Tree	8-25	
Melaleuca sieberi	Small leafed paperbark	tree	2-5	
Large tree – wetland system				
Casuarina cunninghamiana	River she oak	Wetland B / tree	10-35 (<1/m^2)	
Elaeocarpus obovatus	Hard quandong	Wetland B / tree	5-30 (<1/m^2)	Moist soils, tolerates water logged soils hardy and fast growing
Lophostemon confertus	Brush box	Wetland B / tree	10-30 (<1/m^2)	Moist deep alluvial clay soils or moist sandy soils

Lophestemon suaveolens	Swamp box	Wetland B / tree	5-25 (<1/m^2)	Moist sandy soils
Melaleuca nodosa	Prickly leafed paperbark	Wetland B / tree	2-7 (2-4/m^2)	Deep sand s and moist sandy soils
Melaleuca quinquenervia	Broad leafed paper bark	Wetland B / tree	8-25 (<1/m^2)	Very moist soils and alluvial soils, tolerates inundation
Melaleuca sieberi	Small leafed paper bark	Wetland B / tree	2-10 (<1/m^2)	Moist sandy or poorly drained soils

Species marked with a * are identified by FAWB as having effective nutrient removal

Species marked with a # are SEQ WBD core functional plant species

PART 4

TECHNICAL GUIDELINE

FOR

WATER

RETICULATION

DESIGN

4 Technical guideline for water reticulation design

4.1 Introduction

This document outlines The City's recommended practice for design and construction of water reticulation.

It is intended to be read in conjunction with documents referenced in Section 4.2.

The design for Water Reticulation should be made with consideration for other services. Guidance for Roads, Stormwater, Sewerage Reticulation and Landscaping can be found in the sections of this document as follows.

Part 1 General requirements

Part 2 Technical guideline for roads

Part 3

Technical guideline for stormwater drainage design and WSUD

Part 5 Technical guideline for sewerage reticulation design

Part 6 Technical guideline for landscaping

Part 7 Technical Guideline for Bulk Earthworks and Retaining Walls

4.2 References

This section of the Technical Guideline should be read and utilised in combination with the following publications as referenced throughout;

- Water Supply Code of Australia, WSA 03-2011, Version 3.1, *Water Services Association of Australia* [WSA 03-2011]
- AS/NZS 2280 Ductile Iron Pipes and Fittings
- AS/NZS 4087 Metallic Flanges for Waterwork Purposes
- AS 1432 Copper Pipes for Plumbing, Gas fitting and Drainage Applications
- National Construction Code - Volume 3 Plumbing Code of Australia
- National Construction Code - Volumes 1 & 2 Building Code of Australia
- AS/NZS 2544 Grey Iron Pressure Fittings
- AS/NZS 3500 Plumbing and drainage suite
- AS/NZS 2648 Underground marking tape Non-detectable tape
- AS 1100 Technical drawing Engineering survey and engineering survey design drawing

4.3 Classification of mains and areas for water supply

The City can provide guidance to Developers for which parts of the Coffs Harbour LGA require reticulated water. Areas that are to be provided with reticulated water are those where:

- Treated water is/must be supplied at full mains pressure; and

- Fire fighting is to be supplied via the reticulation through the provision of hydrants.

Trunk and distribution mains are those pipelines which transfer water to reservoirs, link reservoirs or areas of demand, or distribute water to or through areas of development. These pipelines are of strategic importance to the operation of the reticulation system irrespective of size.

4.4 General requirements regardless of area

4.4.1 Design

Any development application that involves changes or extension to the City's existing water infrastructure, or construction of new water infrastructure, must be accompanied by documentation that complies with the requirements detailed in the following sections including plans and calculations at the time of submission.

4.4.2 Servicing strategy

All design elements submitted must comply with the Servicing Strategy approved by the City as part of the conditions of development consent issued for the subject development, as appropriate.

Changes to the approved Servicing Strategy must be approved by the City prior to the submission of plans and associated documentation.

4.4.3 Future demands

Water supply components are to be sized to cater for proposed future development. The City's current reticulation analyses will be used as a guide in assessing size requirements.

In certain cases where Developers are requested by the City to construct infrastructure that caters for future demand as well as their own development, the City will reimburse the difference in cost between constructing the larger components and the size required to supply the development. The cost of reimbursement to the Developer for the upsizing of a main shall be negotiated with the City.

4.4.4 Plans and calculations

The water reticulation design – checklist in Appendix A shall be completed and submitted with the drawings. Should any of the items included in the checklist be outstanding or not to a standard acceptable to the City, the drawings shall be returned to the developer for amendment. The City shall only commence review of the design drawings once it is satisfied that all the requirements of the checklist have been met.

Design drawings and calculations shall be submitted to the City for approval. Information to be included in the design drawings are detailed in Appendix B. The completed checklist shall be submitted with the drawings.

Note watermain long sections for 100mm mains or smaller are generally not required unless specified by the City.

4.4.5 Structures

Detailed engineering drawings are required for any structures such as reservoirs, pumping stations and valve pits and aerial crossings proposed for construction in conjunction with water supply works.

4.4.6 Locations and cover

Water mains are to be located on the footway in accordance with the footway allocations referred to in Part 2 of this Technical Guideline and shall extend to the extremity of the development.

The minimum depth of cover to pipelines, measured from the finished ground surface level to the top of any socket, shall be in accordance with the manufacturer's instructions and shall be minimised where possible to avoid excessive excavation and depth of service connections. Notwithstanding the manufacturer's requirements for cover, minimum cover required in footways and driveways, and under road carriageways shall be:

- 750mm where the main is located within an embankment;
- 600mm where the main is located within a roadway or commercial area; and
- 450mm elsewhere.

The depth of cover may need to be increased for larger diameter mains to accommodate larger fittings, to accommodate service connections or to resolve clashes with other infrastructure. Where located in classified road carriageways or railway corridors, cover shall be as approved by the respective Roads Authority or Rail Authority.

The City may give approval for infrastructure to be located in areas other than road reserves provided an easement is created. The Developer should transfer to the City any water easements provided in the subdivision and execute a transfer and grant of easement in favour of the City pursuant to Section 88B of the Conveyancing Act 1919, as amended. The minimum width of water easements shall be 3.0m for reticulation mains and 5.0m for trunk mains.

The City may require water mains to be located on both sides of the road in commercial/industrial areas, in areas likely to have high or medium density housing and on highly trafficked roads.

Water mains are to be provided for the full extent of the development to facilitate the systematic and orderly expansion of the City's infrastructure.

4.4.7 Mains in cul-de-sacs

Where the cul-de-sac incorporates a pathway to an adjacent street or ends in a park, the water main is to extend through the pathway or park so that a dead-end is not created in the main.

Where a pathway or park is not provided, the main is to be returned at the end of the cul-de-sac to form a loop main which should conform to the following criteria:

1. The loop is to be totally on the footway, apart from the one road crossing required to reconnect with the main;
2. The loop is to incorporate a minimum of 3 separate service tapping's, each separated by at least one block frontage;
3. A hydrant is to be provided within the loop approximately equidistant from loop back point;
4. The loop is to cross the road perpendicular and at the start of the neck at the Cul-de-sac; and
5. Changes in direction of the main shall be achieved through the installation of deflection fittings, by deflections at pipe collars or via a curved alignment where High Density Polyethylene is utilised. All fittings, deflection and curve radius shall be within the manufacturer's tolerance guidelines.

63mm diameter HDPE mains are permitted in cul-de-sac loops provided the length of main is not greater than 50 metres and there are a maximum of 5 service connections.

4.4.8 Hydrant, flushing point and stop valve chambers

Around each valve, hydrant and flushing point, a shroud of the type shown in the City Standard Drawing 400 series shall be provided. An ant barrier system shall be provided between the shroud and the underside of the hydrant unit.

Unless otherwise specified, each valve and shroud should be covered by a surface box as shown on the City Standard Drawing 400 series. The material type for the surface box shall be plastic when the valve is located within a footway or cast iron when located within a road. The valve box shall be constructed flush with the adjacent ground surface and where located within a footpath, the path shall be locally thickened and reinforced to provide support under the valve box as per the City standard drawings 300 series.

4.4.9 Existing stop valves and hydrants

Where the subdivision is utilising existing water mains, the level of hydrant and stop valve surface boxes should be adjusted to suit new surface levels.

4.4.10 Detector tape

A metal detectable tape complying with Australian Standard AS/NZS 2648 and green in colour shall be laid with water mains constructed from material other than Ductile Iron Cement Lined in accordance with the manufacturer's specifications. At a minimum such tape shall be continuous and electrically bonded to metallic components including services and standpipes.

4.4.11 Tapping bands

Approved tapping bands are to be used for all service connections. Tapping bands including hard stop design will be required when using non DICL pipe material. Thin brass type tapping bands will not be permitted. Readytap, multi-tap and wang connectors or equivalent are acceptable. See Standard drawings 400 series for tapping band and ready tap connection details

4.4.12 Water meter installation

The City requires that all lots, including areas set aside for recreation, be provided with a water meter in a location as detailed in the City Standard Drawings 400 series. The Developer shall pay the applicable fees and lodge a Water Service Application prior to the subdivision release. This form is available on the City's website https://forms.coffsharbour.nsw.gov.au/RunForm.aspx?formId=1455

The City will supply and install water meters once the applicable fees and charges have been paid and upon registration of the subdivision and following receipt of a request for water meter connection from the property owner.

4.4.13 Shared trenching

4.4.13.1 *Footways*

Shared trenching will not be permitted.

4.4.13.2 *Road crossings*

All road crossings are to be provided at right angles to the road centreline at the point of crossing unless agreed otherwise with the City.

Shared trenches will be permitted between utilities provided the minimum horizontal separation and vertical clearance between utilities is in accordance with Table 5.5 of WSA-03 2011.

Fill between the conduits within a shared trench shall be as detailed in the City Standard Drawing 400 series.

4.4.14 Pipe/fittings connection

Connection of pipes shall be in accordance with the manufacturer's specifications.

4.4.15 Pressure reducing valves

Where Pressure Reducing Valves (PRV's) are required they shall be of a type and design approved by the City.

Pits to house PRV's shall be constructed from concrete, or other suitable material, and shall allow a clear work area of at least 600 mm in all directions around the PRV. A drain shall be located in the bottom of the pit which drains to an adjacent water course or drainage structure. Dismantling joints shall be provided on one side of the PRV and an isolation valve shall be provided on the other side. The City's preference is for the isolation valve to be on the feeder side of the PRV. The pit shall be fitted with lockable removable covers (such as McBerns (LFM type)). The Developer shall contact the City to determine the preferred cover type based on safety and maintenance requirements.

4.4.16 Opening of valves

The developer is required to establish that all valves and service connections are fully open, following construction as appropriate.

4.4.17 Thrust blocks

Valves, flexible jointed bends, tees, dead ends, and other points in the pipeline where there are unbalanced forces should be adequately restrained to withstand the forces resulting from the internal pressure when the pipeline is in use by packing between the fitting and the side of the trench with concrete as detailed in the City Standard Drawing 400 series. The forces acting on a thrust block shall be determined by the greater of 1200 kPa test pressure or a test pressure of 25% higher than the allowable operating pressure of the main.

All stop valves shall be restrained by a thrust block in accordance with the City Standard Drawing 400 series.

The Developer shall be responsible for any failure of the pipeline that may be due to inadequate restraint in accordance with in the City Standard Drawing 400 series.

4.5 Water reticulation areas

4.5.1 Minimum requirements

The city requires that all allotments designated for water reticulation, including areas set aside for recreation, be provided with a reticulated water supply sufficient for both domestic and fire fighting purposes.

The water supply system components should be designed generally in accordance with WSA 03-2011 and the City requirements as detailed in the Technical Guideline.

4.5.2 Water demand

A peak instantaneous demand of 0.15 L/s/tenement shall be used except that when supplying more than 1000 tenements, a demand of 0.1 L/s/tenement shall be used. Water demands for other industries shall be as detailed in WSAA 03 Part 1, Section 2.2.

4.5.3 Static head

Reticulation systems shall be designed to supply peak instantaneous demand by gravity at the meter location for each lot while maintaining a minimum static head of 200 kPa (20m). The minimum static head of 200 kPa is required when the service reservoir is one third depleted.

The main shall be capable of delivering peak instantaneous demand to each lot, while maintaining a minimum head of 12m throughout the system with the service reservoir assumed to be two thirds depleted.

4.5.4 Desirable maximum and minimum service pressure

The desirable maximum service pressure for residential, industrial and commercial areas is 600 kPa. Zoning of the reticulation system by means of pressure reducing valves (PRV's) may be necessary to achieve these pressures across the development.

The desirable minimum service pressure is 200 kPa for residential areas and 250 kPa for industrial and commercial areas.

4.5.5 Maximum pressure

The maximum pressure applied to a component of an in-service pipeline shall not exceed the safe working pressure of the component. The effect of water hammer shall be taken into account for the maximum pressure.

The maximum pressure applied to a component for field testing, including water hammer, shall not exceed the field test pressure recommended by the component manufacturer.

The maximum pressure during field testing or in-service along a pipeline shall take into account the permitted forces that can be applied to pipeline support structures such as thrust blocks.

4.5.6 Service reservoirs

Minimum capacity is one day's supply at future peak day demand with a minimum design life of 50 years.

4.5.7 Pipe size

The minimum acceptable pipe size is 100mm diameter for residential areas and 150mm diameter for commercial and industrial areas.

63mm diameter mains are permitted in cul-de-sac loops provided the length of main is not greater than 50 metres and there are a maximum of 5 service connections.

100mm diameter dead end mains shall incorporate a flushing point at the end of the main (such as a duck foot hydrant), are to be limited to 150m in length and should serve no more than 40 residential dwellings.

A branch that that solely services a private development shall be one size smaller than the mainline pipe size.

4.5.8 Mains and fittings

4.5.8.1 *Materials*

All mains must be constructed from material which is compatible with Ductile Iron fittings.

Water mains shall be constructed from either:

- PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with AS/NZS 2280;
- PN16 Series 2 PVC-O and PVC-M in accordance with AS/NZS 4441;
- PN16 or SDR11 HDPE in accordance with AS/NZS 4130; and

- An alternative material at aerial pipe crossings may Mild Steel Cement Lined (MSCL) pipe with corrosion protection system in accordance with DR WSA 201-2017-2.1 such as sintakote or approved equivalent may be used.

All water mains crossing the carriageway/roadway shall be constructed of Ductile Iron Cement Lined pipe from fitting to fitting regardless of the size of the main.

All cast or ductile iron fittings shall be cement or epoxy lined and conform to AS/NZS 2280. Stop valves and scour valves are to be anti-clockwise closing (ACC) and resilient seated, with stop valves to have a minimum pressure rating of PN16.

For flanged pipes, the pipe barrel is to be manufactured to AS/NZS 2280 flanged class.

Flanged fittings should be cement or epoxy lined and conform to AS/NZS 4087 and AS/NZS 2280 with a minimum pressure rating of PN16 or PN35 depending on the application.

All ductile iron pipes shall be wrapped in a polyethylene sleeve in accordance with AS 3680. Sleeves shall be colour coded blue for potable water, lilac for reclaimed water and cream for sewer.

4.5.8.2 *Hydrants and valves*

Fire hydrants along each water main are to be provided at a maximum 60 metre spacing in residential areas and at maximum spacing of 160 metres in rural residential areas and at all dead-ends.

Water reticulation mains with water service connections may incorporate a hydrant at high points to relieve entrapped air and a hydrant at low points to allow the main to be flushed. The location of hydrants shall be determined by taking into account the high and low points to ensure an appropriate and regular spacing is adopted.

Water distribution mains without water service connections require an air valve at high points and a scour valve at low points.

Where air valves are required, they are to be installed with an air isolation valve to allow maintenance of the air valve without shutting down the main.

Scour valves are to be discharged to an approved stormwater drainage pit or an approved adjacent water course or stormwater facility when drainage pits are not available.

Stop valves are required at all pipeline intersections and branches so that each section of the line can be isolated separately. This is typically achieved through a 3 way valve assembly. A hydrant shall be provided within the 3 way assembly.

The City accepts the use of a combi valve for the 3 way valve assembly.

Reticulation water main valves are to be Counterclockwise Closing. Reuse water main valves are to be Clockwise Closing.

Where kerb and gutter is constructed adjacent to the main the locations of stop valves and hydrants shall be delineated by formed kerb impressions and a blue raised reflective pavement marker perpendicular to the location of the hydrant and offset approximately 200mm from the centreline of the road. Lettering for kerb impressions shall be in accordance with Section 4.5.8.3.

Where no kerb and gutter is available the locations of stop valves and hydrants should be delineated by galvanized steel marker posts and indicator plates erected on the footway, at the property line, perpendicular to the location of the valve or hydrant.

The City Standard Drawing 400 series, provides details regarding posts and indicators.

All maincocks, hydrants, stop valves, scour valves and air valves are to be located on the footway, unless approved otherwise. If valves or hydrants are required to be located within the road pavement, they shall be located clear of the wheel path and hydrants shall be located clear of parking areas so they are accessible at all times.

Hydrants and Valves are not to be located within table drains.

Hydrants and Valve covers shall open in the direction of the main and the hinges of the cover box located on the approaching side of the direction of travel.

4.5.8.3 *kerb impressions*

Lettering for respective infrastructure to be as follows;

SV – Stop valves,

SCV - Scour valves

H – Hydrants

W – Water mains, water service

AV -Air Valves

In addition the following kerb impressions should also be made to indicate the location of relative infrastructure.

RWM – Reclaimed water main

S – Sewer main

SRM – Sewer Rising Main

G – Gas

T – Telecommunications

E - Electrical

Kerb Impressions are to be installed as per the City Standard Drawing 400 series

4.5.8.4 *Trench drainage bulkheads and trench stops*

Trench stops or concrete bulkheads are required for water main grades equal to or greater than 5% in accordance with TRC Standard Drawing W1200 Series. Spacing requirements based on the grade of the main are specified in Table 4-A

Table 4-A - Trench stop and bulkhead spacing

Type	Grade (%)	Horizontal spacing (m)
Trench Stop	≥5% and <15%	100/Grade (%)
Concrete bulkhead for all water mains at grades of 15% or greater	≥15% and <30%	80×standard pipe Length / Grade (%)
	≥30% to 50%	100/Grade (%)
	>50%	Special design

Adequate trench drainage is required to prevent trench scouring and subsidence due to high permeability of the bedding and trench fill.

4.5.9 Service connections

Water services shall be connected to reticulation water mains. Connection of water services to trunk water mains is not permitted as per the City's Policy "Water connection to rising and trunk mains" except under exceptional circumstances, as outlined within the policy.

4.5.9.1 *Materials and size*

Short side residential water service connections shall be 25mm internal diameter Type A drawn copper pipe with 1.4mm wall thickness, manufactured in accordance with AS 1432.

Long side residential water service connections shall be 25mm internal diameter PE100 PN16 Polyethylene (blue stripe) manufactured in accordance with AS 4130 and located within a 40mm internal diameter PVC conduit or 50mm internal diameter PE100 PN16 Polyethylene (blue stripe) conduit to allow repair or replacement as required.

The minimum size water service in commercial and industrial areas is 25mm internal diameter Type A drawn copper pipe. The Developer shall determine the required water service size based on demand and fire fighting considerations. Services crossing the roadway within commercial and industrial areas shall be laid within 100mm diameter uPVC PN9 conduits.

Recreational water service connections shall be 32mm outside diameter PE100 PN16 Polyethylene with a 20mm diameter meter.

The size of water services serving multiple dwellings, flats or units will vary as specified in Table 4-B.

Table 4-B Minimum size of water service

Class of building	No. of dwellings	Service size (mm)	Maximum length (m)
Class 1 single dwelling house	1	20/25	130
Class 1&2 excluding single dwelling house	1	25	100
	2	25	100
	3-5	32	100
	6-10	40	100
	11-16	50	100

Notes: Classes are defined in the National Construction Code of Australia - Volume One

Limitations of Method:

1. Total length as measured from the water main to the last branch offtake is not to exceed the total length as stated above.
2. Height of the highest fixture above the water main is not to exceed 4m, where the minimum mains pressure is 15m (150 KPa).

Fittings at joints, branches and bends are to be brass or copper capillary fittings or of a type approved by the City. Ball valves and elbows are to be of brass and of a type approved by the City. Any proposed amendments to the materials above shall be as approved by the City.

4.5.9.2 *Location*

Water services are to be laid at right angles to the road centreline and parallel to the radius on curves and in cul-de-sac ends.

Water services shall have a minimum cover of 300mm within a footway and the greater or 500mm or 100mm below the top of subgrade within a road.

The service is to terminate inside each lot in accordance with the City Standard Drawing 400 series. The minimum distance between two (2) adjacent tapping bands is 600mm.

All maincocks shall be located within the footway.

Conduits may be laid for future proposed services, however the service is not to be connected to the water main.

Fire fighting water service shall be contained within the lot served.

Where the water service crosses kerb and gutter, the location of the service shall be delineated by formed kerb impressions perpendicular to the location of the service. Lettering for kerb impressions shall be in accordance with Section 4.5.8.3.

4.6 Pump Stations

In line pressure booster pump stations and ancillaries for a reticulated water supply system shall be designed to the requirements of this Guideline and WSA-03

4.6.1 Booster set and pump selection

4.6.1.1 *Flows*

The booster and pumps provided on reticulated water mains shall be designed to achieve the peak water demand specified in Section 4.5.2.

Where fire fighting flows are required, the available flow at the connection point must satisfy all fire flow requirements of AS/NZS 2419.1 and as a minimum shall include:

- All hydrant flow must be calculated at PH PDD;
- Residential and rural areas shall achieve 10L/s flow from any hydrant with a residual pressure of 150 kPa; and
- Commercial and industrial areas shall achieve 15L/s flow from two adjacent hydrants operating simultaneously with a residual pressure of 150 kPa.

The network pressure available at any property connection point shall be adequate to maintain not less than 120 kPa positive pressure head throughout the system. This includes maintaining the desirable minimum service pressure of 200 kPa.

4.6.1.2 *Pumps*

The maximum number of pumps in a booster set is four and identical pumps are permitted.

4.6.2 Pressure accumulator tank

4.6.2.1 *General*

Pre-charging of the pressure accumulator tank is permitted. Post charging shall be at the City's discretion.

4.6.3 Power system and supply

4.6.3.1 *General*

The primary power supply to the booster set shall be 3 phase, 4 wire, 400 V, 50 Hz, multiple earthed neutral (MEN) system with capacity to operate at full pumping load.

A duplicate power supply from the electricity supply company may be required for large, critical or environmentally sensitive stations, or in areas where the electricity supply is unreliable. Each station shall be evaluated individually in relation to the reliability/security of power supply.

The prospective fault current shall be determined by the designer shall design the electrical protection to withstand the prospective fault current level of the incoming supply at the equipment location

4.6.3.2 *Site specific substation*

If a site specific substation is required for the pumping station, the designer shall determine the following:

- Location of substation;
- Type of service;
- LV connection point and route of the distribution mains to the point of supply;
- Protection equipment, particularly any LV transformer output protection; and
- Easement details

The designer shall provide for short circuit and overload protection at the transformer secondary supply using fault current limiting circuit breakers with adjustable overload and short circuit current setting features, where secondary output supplies are required to be installed by the electricity distributor.

The designer shall Include full discrimination and cascade protection with the electricity distributor's incoming supply protection system and the downstream site protection devices.

4.6.3.3 *Customer owned substation*

If a High Voltage (HV) supply is provided to the pumping station site, the HV supply shall meet the requirements of the electricity distributor for the following:

- HV reticulation;
- HV protection; and
- Set out Low Voltage (LV) facilities and LV transformer protection in electricity distributor dedicated substations.

4.6.3.4 *Electrical mains*

On-site electrical mains shall be located underground between the electricity supply and the switchboard for the pumping station.

The point of supply for LV sites shall be one of the following types:

- Where from overhead supplies, pole mounted at the site boundary;
- Where from underground supply, a private underground termination enclosure at the site boundary; and
- Where directly connected customer's mains, run underground from the electricity distributor's connection point to the main switchboard.

Where customer's mains are utilised, the design shall provide for customer's mains, associated services and all necessary fault and overload current protection equipment to AS/NZS 3000 Section 3, the local electricity distributor's standards, the local Service and Installation Rules.

The minimum size of the customer mains shall conform to the following requirements:

- Current carrying capacity to suit the maximum demand with an excess current carrying capacity of 30% minimum;
- A voltage drop less than 1.5% of the maximum demand as calculated;
- Single core PVC/PVC cables or XLPE insulated cable; and
- Pole termination method: Determine in consultation with the Local Supply Authority.

Where protected customer's mains are utilised, the design shall provide for short circuit and overload protection, where required by the electricity distributor.

Electricity distributor's service protective devices:

- Low voltage service protective devices: To AS/NZS 3000, the electricity distributor's requirements and the supply authority service and installation rules; and
- For service protective devices > 100 A: Provide for fault current limiting circuit breakers with adjustable overload and short circuit current facilities with full discrimination and cascade protection between the incoming supply protection systems and the downstream protection systems.

4.6.4 Electrical design

4.6.4.1 *General*

The pump station shall be designed for fully automatic operation in the unmanned condition to MEW E101 (NSW) Electrical Services Minimum Requirements.

4.6.4.2 *Power and control cubicle*

The power and control cubicles shall be documented in accordance with AS/NZS 3439.1 or AS/NZS 61439.1.

If more than one item of equipment is designed to perform a particular function, all such items of equipment shall be identical and completely interchangeable (e.g. pilot lights, pushbuttons, relays, etc.).

Ambient conditions shall be based on the local area.

The switchboard construction form should generally be Form 2 to AS/NZS 3439.1 or to AS/NZS 61439.1. Telemetry and communications equipment shall be segregated from the power and control sections of the switchboard.

The switchboard shall be located in a visible location on a concrete plinth. The design shall include plinth details and physical protection. Where the switchboard is located in flood prone areas, it shall be located a minimum of 500mm above the1% AEP flood level on suitable support structures. Suitable access facilities and working platform shall be provided in front of the switchboard for safe operation of the equipment.

Electronic phase failure shall be relayed to monitor the incoming power supply, incorporating:

- Detection of undervoltage (80% of normal voltage);
- Voltage or phase angle imbalance;
- Reverse phase sequence; and
- 10 A fuse protection for connection to the three supply phases.

Surge protection shall be provided by Type I SPD shunt connected metal oxide varistor based SPDs between each phase and neutral at assembly incoming supply terminals, if required by the electricity distributor.

Surge protection devices shall conform to IEC 61643-11 and IEC 61643-12 and shall be installed to AS/NZS 3000 Appendix F.

The designer shall consider power factor correction requirements, the energy cost in running the pumping station and cost savings to justify the installation of power factor correction equipment.

Where mobile generators are required, the designer shall consider incorporation of safeguards to prevent inadvertent simultaneous connection of mains and generator power. Where necessary, provide for mechanical interlocks and an isolation device or changeover switch, to switch the mobile generator supply to the switchboard.

Where environmental conditions may cause condensation to occur within the switchboard, thermostatically controlled anti-condensation heaters shall be provided to weatherproof switchboards with an external surface area greater than 4 m^2 based on 40 watts/m^2 of exposed surface area. Provide for heaters of the black heater type, mechanically protected and able to be touched without harm.

Lightning and surge protection shall be provided to all incoming power supply and control power supply.

4.6.5 Motor starters

4.6.5.1 *General*

Electronic Variable Speed Drive (VSD) starters and motor control devices shall be provided for the control of water booster pumps to AS/NZS IEC 60947.4.2.

Each boost pump shall include the following electrical control and protection equipment:

- Circuit breaker rated to protect the pump submain and the motor; and
- Hybrid VSD motor controller/starter.

4.6.5.2 *Circuit breakers*

Moulded case or miniature circuit breakers with full discrimination and cascade protection for overload and short circuit conditions shall be provided in accordance with AS/NZS 3111.

4.6.5.3 *Hybrid VSD motor controller/starter*

Hybrid VSD motor controller/starter shall be provided in accordance with AS/NZS IEC 60947.4.2 and shall comprise of:

- Main line contactor rated for the motor current;
- Electronic VSD starter and controller;
- Thermal overload protection; and
- Thermistor protection of motor windings on motors nominally over 15 kW.

The main line contactor shall be in accordance with AS/NZS IEC 60947.4.1 and contain the following features:

- Block style electromagnetic, air break type generally from the one manufacturer;
- Rated duty: Intermittent class 12;
- Utilisation category: AC-3 or DC-3, as applicable;
- Mechanical durability: 10;
- Contact life: 1 million operations at AC-3 or DC-3, as applicable;
- Three phase contactors: Minimum rating of 16 A, 415 V at category AC-3, rated for the actual motor current at category AC-3; and
- Design: To allow for fitting of auxiliary contacts with rating (Ie) of 4 A at 240 V AC.

Electronic VSD starter and controller shall comply with AS/NZS IEC 60947.4.2, AS 61800.2, AS 61800.3 and the following:

- Functional features: To AS 61800.2 clause 3;
- Automatic restart in the event of failure;
- Breakaway torque adjustment;
- Motor starting current limit adjustment;
- Adjustable acceleration time;
- Adjustable deceleration time;
- Phase loss trip;
- Shorted SCR trip;
- Open circuit output trip; and
- Motor stalled trip.

Thermal overload protection shall comply with AS/NZS IEC 60947.4.1 and the following additional features:

- Single phase fault protection utilizing differential trip bar mechanisms operating at 60% of motor full load rating under single phasing conditions particularly for delta wound motors;
- Incorporated in motor protection design where thermistor protection is required; and
- Manual reset on overload trip unless design conditions dictate automatic reset.

Where motors are rated 45 kW and above, electronic motor protection relays shall be provided in lieu of thermal overload protection relays.

Protection CTs and connection of electronic motor protection relays to the secondary side of the CTs shall be provided where motor currents do not allow for direct connection of the relays into the motor circuit.

4.6.6 Control and telemetry systems

4.6.6.1 *General*

All control systems shall be compatible with existing systems, terminology and processes used by the City. These shall include, but not be limited to:

- Pumping control;
- Alarms; and
- Telemetry system.

The telemetry system shall be capable of connection to the City's SCADA telemetering system.

A stand-by power supply, rated at a minimum of an 8 hour power supply failure (or as specified by the City), shall be provided as a backup power supply. All telemetry hardware shall have suitable lightning and surge protection and shall be housed within the cubicle.

Provision shall be made for connection to SCADA for monitoring and control including water pump station, reservoirs and tanks, control valves, flow meters and chambers.

4.6.6.2 *Instrumentation*

The design drawings and/or specification shall specify suitable indicating instruments to monitor parameters required by the City such as flow, pressure, level, speed, voltage, current, power factor, hours run, etc.

4.6.6.3 *Fire flow operation*

Where required by the City, the booster shall be designed for all pumps to operate simultaneously under 'fire flow operation' conditions, in which case the control philosophy, control parameters and set points for 'fire flow operation' shall be specified by the City.

4.6.6.4 *Alarms*

Alarms (locally displayed and remote) and control systems and the level of monitoring shall be specified in accordance with the requirements of the City.

If outer security doors are specified for the booster building or enclosure, meters and alarms shall be located on the inner switchboard doors. Flashing lights shall not be used without approval of the City.

Alarms shall be set to automatic or manual reset in accordance with specific City requirements.

Unless otherwise specified by the City, the digital input signals shall be made available and wired into a dedicated labelled terminal strip. The specification shall include a requirement to wire all signals from the dedicated terminal strip to an RTU cubicle marshalling terminal strip and thence to the RTU.

4.6.7 Pump station structure

4.6.7.1 *General*

Pump units shall be secured in a purpose-designed building subject to Development Approval (DA). Considerations include aesthetics, climate, acoustics, WHS, clearance for maintenance, trip hazards, confined spaces and ventilation.

The location of structures shall consider site access, site maintenance and restoration, easement, power supply and working area when locating pump stations in road reserves or on private property.

The size of the structural shall suit the dimensions of the selected equipment including support, handling and access. There shall be provision for safe and ergonomic access around all pumps, equipment and electrical components.

Where the pump station structure is located within a flood prone area, the floor of the pump station or top of pump well, as appropriate, shall be located 1 m above the 1% AEP flood level.

4.6.7.2 *Structure*

The design of the structure shall conform to the Australian Standards relevant to the structure being designed.

If below ground level, pumps shall be mounted on plinths and housed in a single pump well. Drainage shall be provided to prevent flooding of the well.

Where the pump well is located within or below the ground water table, they shall be designed against flotation, both during the construction/installation and operation under flood conditions designed as above. A factor of safety of 1.25 shall be provided against flotation.

4.6.7.3 *Ladders*

Access ladder shall be provision in accordance with AS 1657.

Intermediate ladder landings shall be set in wells to achieve the minimum head room clearance. Wherever possible, locate the landing adjacent to fittings and machinery requiring maintenance.

Ladder cages shall not be used in pump station wells.

4.6.7.4 *Covers*

Access and inspection covers shall be designed for the possibility of site flooding ingress and overflow, and WHS requirements.

4.6.7.5 *Electrical requirements for pump station buildings*

Where the pumping equipment is installed within a pump station building, the following shall be provided:

- Lighting within the building utilising sealed corrosion resistant lighting fittings;
- 10 A, 240 V switched power outlets. Quantity and location to suit pumping station requirements;
- 15 A, 240 V switched power outlet suitable for electric welding requirements; and
- Residual current device protection to AS/NZS 3000 requirements.

Light switches and power outlets shall be ironclad or high impact polycarbonate industrial type.

Electrical accessories shall be housed in heavy duty PVC-U conduits. Pumping equipment shall be located housed within heavy duty conduit on a tray or cable ladder.

4.7 APPENDIX A – Checklists – Water reticulation design

Item No.	Description	Reference	Developer confirmation	City confirmation	Comments
1	Water servicing strategy	4.4.2			
2	Future demands	4.4.3			
3	Water reticulation areas	4.5			
4	Infrastructure required to allow water pressure and chlorination testing of new mains				
5	Design departure application and approval documentation	1.6			

4.8 APPENDIX B – Information to be shown on Water Reticulation Drawings

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
1	**General**			
1a	Cover sheet with locality plan, list of drawings and DA number			
1b	Plans prepared in A1 format at a scale of 1:500			
1c	Drawing scale is shown on drawings as a bar scale			
1d	Scale of detail drawings is shown as appropriate			
1e	Schedule of symbols			
1f	Benchmark within 100 metres of development site is shown			
1g	North point shown			
1h	Site topography is shown via contour lines			
1i	Datum reference including benchmark at AHD adopted by NSW Department of Lands			
1j	Each plan to be numbered with revision no. and revision schedule			
1k	Road names or number			
1l	Drawings to be signed by respective consultant / engineer			
1m	Lettering, line work and symbols to conform to AS 1100			
1n	Water mains to be shown on road cross sections			
1o	Each plan to be numbered with revision no. and revision schedule and revision date, with a cloud around revisions with a revision no.			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
2	**Water layout plans**			
2a	Existing water mains and services are shown			
2b	Lot boundaries and numbers shown			
2c	Pipelines are numbered			
2d	Pipeline centreline chainages are shown			
2e	Pipeline diameters are shown			
2f	Terminations at cul-de sac's through pathways, reserves or loop shown			
2g	Location and size of water services shown			
2h	Type and class of pipe work and fittings clearly indicated			
2i	Location of hydrants, stop valves especially at intersections, scour valves, air valves and other fittings to be shown			
2j	Alignment of mains and services in accordance with respective footway allocations for urban and rural residential			
2k	Location of proposed easements reserves etc. incl. downstream if required			
2l	Location of all drainage lines, sewer lines and other utility lines crossing the mains to be shown			
2m	Limit of construction to be shown including staging			
2n	Mains to be extended to the full length of the subdivision			
2o	Service connection to each block			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
2p	A hydrant is to be located at dead ends			
2q	Hydrant spacing to be as per the technical guideline			
2r	Thrust blocks to be indicated where required			
2s	Water services at right angles to road centreline and parallel to the radius on curves and in cul-de-sac ends			
2t	Metal detectable tape to be shown when non metallic pipe is proposed			
3	**Water longitudinal sections**			
3a	Sections are drawn at scale of 1:500 horizontal and 1:100 vertical or as appropriate			
3b	Levels to be shown at 20m chainage intervals, changes in grade, high and low points and pipe junctions			
3c	Chainages as per layout plan			
3d	RL of existing surface, design surface and pipe invert at each location of 3b above and at major variations in natural surface such as roads, gullies etc.			
3e	Location of hydrants, stop valves, scour valves, air valves and other fittings			
3f	Design grades including extent of each gradient			
3g	Pipe diameters and material type and class to be shown			
3h	Air valves or hydrants at high points			
3i	Scour valves at low points			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
3j	Location and size of existing and proposed services and utilities crossing the main complete with invert levels and clearances			
3k	Sections to be taken along intersecting roads for a sufficient distance to allow connection design			
3l	Trench stops and bulkheads shown as required on steep grades			
3m	All new water services to be shown			
3n	Mains satisfy cover requirements			
4	**Miscellaneous**			
4a	Show differing water supply zones if applicable			
4b	Design is satisfactory for future extension			
4c	Pipe sizes conform to current strategies for future development			
4d	Detailed engineering drawings are required for any structures such as reservoirs and pumping stations proposed for construction in conjunction with water supply works			
4e	All allotments including areas set aside for recreation to be provided with a reticulated water supply sufficient for both domestic and firefighting purposes except where trickle flow has been determined			
4f	Engineering plans and subdivision plans agree			
4g	Engineering conditions of consent included in design plans			
4h	Water service sizes determined in accordance with National Construction Code – Volume 3 Plumbing Code of Australia and AS/NZS 3500			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
4i	Mains to be designed to satisfy minimum cover requirements			
4k	Minimum pipe size is 100mm diameter for residential and 150mm diameter for commercial and industrial areas.			
4l	All details conform to standard drawings including water services, connection details, hydrant and stop valve design, Thrust blocks and trench design			

PART 5

TECHNICAL GUIDELINE FOR

SEWERAGE

RETICULATION

DESIGN

5 Technical guideline for sewerage reticulation design

5.1 Introduction

This document outlines the City's recommended practice for design of sewerage reticulation. It is in no way a comprehensive "Design Manual" and it is intended to be read in conjunction with and as a supplement to, relevant government department publications.

The other parts of the Technical Guideline for Infrastructure Design are as follows:

Part 1 General requirements

Part 2 Technical guideline for roads

Part 3

Technical guideline for stormwater drainage design and WSUD

Part 4 Technical guideline for water reticulation design

Part 6 Technical guideline for landscaping

Part 7 Technical Guideline for Bulk Earthworks and Retaining Walls

5.2 References

This section of the Technical Guideline should be read and utilised in combination with the following publications as referenced throughout;

- Gravity Sewerage Code of Australia, WSA 02-2014, Version 3.1, *Water Services Association of Australia* [WSA 02-2014]
- Sewage Pumping Station Code of Australia, WSA 04-2005, Version 2.1, *Water Services Association of Australia* [WSA 04-2005]
- Pressure Sewerage Code of Australia, WSA 07-2007, Version 1.1, *Water Services Association of Australia* [WSA 07-2007]
- Manual for Selection and Application of Protective Coatings, DR WSA 201-2017-2.1
- National Construction Code - Volume 3 Plumbing Code of Australia
- National Construction Code - Volumes 1 & 2 Building Code of Australia
- AS/NZS 3500 Plumbing and drainage suite
- AS/NZS 2648 Underground marking tape Non-detectable tape
- AS 1100 Technical drawing Engineering survey and engineering survey design drawing
- AS/NZS 1260 uPVC SN8
- AS/NZS 5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
- AS/NZS 3000 – Electrical Installations – Wiring Rules
- AS 3735 Concrete Structures for Retaining Liquids

5.3 Gravity and pressurised or vacuum systems

The designer shall design a gravity pipeline collection system with pump stations and rising mains, where necessary to comply with the requirements of this technical guideline, to transport fresh sewage, or common effluent, for treatment.

The City's preference is for sewer connections to individual lots to be via gravity sewer. Individual connections in both residential and industrial/commercial areas that cannot be connected to the existing reticulation via gravity may be connected to the existing reticulation via a pump out system, but only after it has been demonstrated to the city that the provision of gravity sewer is not possible. Certain conditions including responsibility for various components of the system may apply.

The design of pressure sewer systems shall be in accordance with the PRO-088 Pressure sewer system procedure and technical specification.

PRO-088 Pressure Sewer System Procedure

5.4 General requirements

The design of sewers is controlled by the requirements of the Technical Guideline as detailed below.

The Technical Guideline applies to the design of sewer in industrial or residential areas including medium density development.

5.4.1 Design

Any development application that involves changes to, or extension of, the City's existing infrastructure, or the construction of new sewer infrastructure, must be accompanied by documentation that complies with the requirements detailed in the following sections including plans and calculations at the time of submission.

5.4.2 Servicing strategy

All design elements submitted must comply with the Servicing Strategy approved by the City as part of the conditions of development consent issued for the subject development, as appropriate.

Changes to the approved Servicing Strategy must be approved by the City prior to the submission of plans and associated documentation.

5.4.3 Future loading

Reticulation components are to be sized to cater for proposed future development. The City's current reticulation analyses will be used as a guide in assessing size requirements.

In certain cases where Developers are requested by the City to construct infrastructure that caters for future loading as well as their own development, the City will reimburse the difference in cost between constructing the larger components and the size required to service the development. For further details please contact the City's planning department.

5.4.4 Plans and calculations

The Checklist contained in Appendix A shall be completed and submitted with the Drawings. Should any of the items included in the checklist be outstanding or not to a standard acceptable to the City, the Drawings shall be returned to the developer for amendment. The City shall only commence review of the design drawings once it is satisfied that all the requirements of the checklist have been met.

Design drawings and calculations shall be submitted to the City for approval. Information to be included in the design drawings are detailed in Appendix B**.** The completed Checklist shall be submitted with the Drawings.

5.4.5 Excavating or building adjacent to or over existing sewer mains

The City has adopted a policy titled "Construction in the vicinity of and protection of Council underground assets". This policy specifies the requirements for building adjacent to or over existing sewer mains.

The policy can be viewed on the City's website in the general policy register at

https://www.coffsharbour.nsw.gov.au/Your-Council/Fees-forms-and-publications/Policies?dlv_OC%20CL%20Public%20DocLib%20Relative=(pageindex=2)

5.5 Gravity Sewer

5.5.1 Locations and cover

Sewer mains shall be located as follows:

a) Gravity sewer mains shall be located at either of the following locations subject to the topography of the site and the lot layout. In each instance, an easement shall be provided within the private property in accordance with Section 5.5.9:

- Within the private property at the front of a lot at an offset of 1.5m from the road reserve boundary
- Within private property at the rear of the lot adjacent and parallel to the rear property boundary

b) Sewer rising mains shall be located within the verge as per the City Standard Drawing 200 series.

A sewer main shall not be located along more than one boundary within a lot.

Where sewer mains are located within lots adjacent to storm water drainage lines, the sewer should be laid with a minimum 0.6m separation between the outside of the sewer and the outside of the stormwater pipe in the horizontal direction. This horizontal separation between pipes may need to be increased subject to the vertical separation between the pipes.

Sewer mains shall extend to the extremity of the development where potential exists for future developments.

Minimum cover required to mains shall be in accordance with Table 5-A and the City Standard Drawing 500 series.

Table 5-A – Minimum cover over sewer mains

Location	Minimum cover to the top of sewer main (mm)
Public and private lots not subject to vehicular loading	600
Private lots zoned residential subject to vehicle loading	750
Footway, nature strips, industrial and commercial lots, sealed road pavement other than major roads subject to vehicular loading	900

Unsealed road carriageways	1200
Major road carriageways	1200

Where located in classified road carriageways or railway corridors, the cover shall be as approved by the respective Roads Authority or Rail Authority.

5.5.2 Lot servicing and soffit requirement

All lots are to be provided with a sewer junction, placed so the whole of the lot can be gravity sewered subject to the following paragraphs.

If the lot is to be serviced from the front, the area to be serviced shall be the total area of the lot.

If the lot to be serviced is from the rear, the area to be serviced shall be the total area of the lot excluding any front setback, or the front and side setback in the case of corner lots.

A 150 millimetre diameter sewer junction is to be provided within each lot. The depth of the junction is to be such that the lot area to be serviced can be drained to it via a pipe with a minimum 300 millimetres of cover laid at a minimum grade of 1.7%.

Regardless of the minimum grading being achieved, the minimum height differential between the soffit of the receiving sewer and the lowest fixture of the house drain connecting to that point is 1.2m mm which may be reduced to 0.9m where:

- The number of properties connected upstream of the subject lot is 10 or less; or
- The grade of the sewer downstream of the property connection is steeper than 3.0%; and the overflow relief gully is installed immediately upstream of the inspection shaft or boundary trap.

In the situations where it can be demonstrated that this soffit requirement cannot be satisfied or an alternative is not possible (ie. set minimum floor level) consideration may be given to the installation of a reflux valve in the house drain on the house side of the junction.

5.5.3 Materials

Reticulation pipelines and fittings may be of any of the following materials manufactured in accordance with the relevant Standards,

- uPVC SN8 in accordance with AS/NZS 1260;
- Twin walled corrugated Polypropylene in accordance with AS/NZS 5065;
- PN16 or SDR11 HDPE in accordance with AS/NZS 4130;
- Gravity sewer mains at road crossings, creek crossings and areas with shallow cover shall be Calcium Aluminate (CA) lined DICL PN35 pipe such as Tyton Extreme or approved equivalent; and
- An alternative material at aerial pipe crossings may Mild Steel Cement Lined (MSCL) CA lined pipe with corrosion protection system in accordance with DR WSA 201-2017-2.1 such as sintakote or approved equivalent may be used.

All pipes shall be rubber ring jointed unless MSCL pipes are utilised, in which case joints shall be welded and suitable stainless steel spigot or PN16 flanged connection to adjacent pipework provided.

PVC pipes are to be maximum 3 metres in length.

5.5.4 Junctions

Where the depth to the invert of the main exceeds 1.5 metres, sewer junctions are to be raised on a vertical shaft as an external drop so that depth to invert is not greater than 1.5 metres as per the City standard drawing 500 series unless otherwise approved by the City.

Where the depth to the invert exceeds 4.0m, a maintenance hole shall be provided in lieu of a junction.

Construction of the vertical shaft is not to be undertaken in cases where it would preclude gravity sewer servicing of the entire lot.

5.5.5 Sidelines

Junctions exceeding 10 metres in length are considered to be a side line and require a maintenance hole where they enter the main. When the sewer main is outside the property boundary the service should be perpendicular to the sewer main.

5.5.6 Marking of junctions and sidelines

The position of each riser, junction or end of a sideline should be clearly marked by the Contractor on completion of backfilling and shall be no further than 2.5m from the front boundary and 1.0m from the side boundary when the main is located within the front of the lot or neighbouring lot and no further than 1m from the side boundary and the centreline of the main where the main is traversing the lot.

A red survey peg should be used to indicate the location of sewer junctions. The peg should be tied to an underground identification tape, connected to the sewer junction. The contractor should adjust the levels of pegs where necessary to conform to final surface level at the time of notification of completion.

As an alternative to providing a red survey peg, a vertical riser can be constructed. The sewer riser is to be marked red, solvent capped, protected from vandalism and easily identifiable for future internal connection.

The position of each riser, junction or end of sideline, dimensioned relative to at least 2 adjacent property boundaries must be shown on Works As Executed drawings to allow location at future date. Distance to junctions from downstream manhole also to be indicated.

5.5.7 Access chambers/maintenance holes

For the purpose of this Technical Guideline, ‘access chambers’ are referred to as ‘maintenance holes’ (MH).

Sewer maintenance holes are required at all changes of grade, changes in pipe diameter, deflections, line intersections and at all dead-ends exceeding 30 metres in length. Refer to standard drawings SD-300-11 for dead ends.

Where sewers of different diameters intersect or join, the maximum depth of the smaller pipe is to be such that the pipe soffits are at the same level.

Maintenance holes shall be either concrete or HDPE. HDPE maintenance holes are only permitted subject to City approval. Where HDPE maintenance holes are proposed, the developer shall provide the City with any requested information, including but not limited to groundwater levels and an assessment of the risk of buoyancy.

Where concrete maintenance holes are adopted, the bases for maintenance holes may be either cast-in-situ or precast whilst shaft sections are to be precast. The developer is required to submit detailed drawings of proposed access structures for approval.

Step irons shall not be installed in sewer maintenance holes due to work health and safety requirements for confined space entry and their deterioration over time.

Sewer maintenance holes should not be located in road carriageways. Where this is not possible and the manhole is agreed with the City that is may be located within the carriageway, a reinforced concrete manhole shall be provided.

Heavy Duty (Class D) covers shall be provided for maintenance holes that are located within the verge or road carriageway,

An internal maintenance hole drop between inlet and outlet of the same diameter is required as follows:

Table 5-B - Internal maintenance hole drop

Deflection Angle	Drop (mm)
0°to 10°	30
10° to 60°	50
60° to 120°	80

Deflections greater than 120° are not permitted.

Maximum spacing for maintenance holes should be as follows:

Table 5-C - Spacing for maintenance holes

Pipe Size(mm)	Maintenance hole spacing (m)
150	100
225	120
300 and above	150

5.5.8 Existing maintenance holes and services

Where the development is utilising existing sewer mains or junctions, the mains, maintenance holes or junctions must be upgraded to meet the current guideline requirements.

5.5.9 Sewer easements

Easements are required over the City's sewer mains located within private property. It is the responsibility of the developer to obtain sewer easements from any other land if required. (The Subdivision Certificate will not be released until the above requirements have been complied with).

The developer should transfer to the City any sewer easements provided in the subdivision and execute a transfer and grant of easement in favour of the City pursuant to Section 88B of the Conveyancing Act 1919, as amended.

The minimum width of sewer easement at the front and rear of lots shall be 3.0m. Where the depth of the sewer main exceeds 3.0m to invert, the easement width shall be increased to 5.0m.

Where the sewer main is located at the rear of a lot, a 2.4m wide easement for access shall be provided along one side boundary of each lot to allow access to the sewer main by the City.

Where the sewer is located in a shared trench with stormwater, the sewer should be located nearest to a lot being served where practical. The width of an easement covering shared infrastructure shall be the size of the two mains plus the space between the mains plus a minimum of 1.5m from the main to the edge of easement.

5.5.9.1 *Gravity pipe design*

Sizing of gravity sewerage pipes should be in accordance with Table 5-E.

5.5.9.2 *Design of system components*

The sewerage system components should be designed generally in accordance with WSA 02-2014, WSA 04-2005 and WSA 07-2007.

5.5.9.3 *Maximum and minimum allowable loadings - reticulation mains*

The minimum size for gravity sewer mains is 150 millimetre in diameter.

Gravity reticulation mains capacity should be greater than or equal to Peak Wet Weather Flow (PWWF) and grading sufficient to achieve self-cleansing velocity at Peak Dry Weather Flow (PDWF).

PWWF is the highest observed hourly flow following the design storm event (1 hour intensity, 0.5 EY (39.35% AEP); see "Design Flows" below). PWWF to be adopted are:

- For undeveloped areas, PWWF = WSA 02-2014 Design Flow;
- For developed areas, PWWF should be the greater of the physically measured/assessed flow (where available) and the WSA 02-2014 Design Flow;
- For a mixture of developed and undeveloped areas, PWWF may be a combination of physically measured/assessed flow (where available) and WSA 02-2014 Design Flow, as directed by the City.

Table 5-E specifies the maximum and minimum allowable loadings for various diameter pipes.

The maximum acceptable grade for any sewer is 1 in 10, whilst the minimum acceptable grades are detailed in Table 5-E.

5.5.9.4 *Values for roughness*

The values of roughness to be used in the design of gravity sewers are detailed Table 5-D.

Table 5-D - Value of roughness

Nominal pipe size (mm)	Full flow – for estimation of peak hydraulic capacity	Partial flow – for estimation of self-cleansing flows
150 – 300	k = 0.6mm	k = 1.5 normal k = 3.0 for control lines
375 – 600	K = 0.6mm	K = 3.0mm
Above 600	K = 1.5mm	K = 6.0mm

Note: Control lines are those lines which affect the overall depth of system.

Table 5-E – Maximum and minimum allowable loadings

GRADING TABLE - GRAVITY SEWERS
150 - 600mm Nominal Size Pipelines

Pipe Diameter (mm)	150			225			300			375		450		525		600			Pipe Diameter (mm)
Grade %	Tenements			Tenements			Tenements			Tenements		Tenements		Tenements		Tenements			Grade 1 in
	K	Min. 1.5	Min. 3.0	Max 0.6	Min. 1.5	Min. 3.0	Max 0.6	Min. 1.5	Min. 3.0	Max 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	K	
1.25	1	1	221																80
1.11	3	2	208																90
1.00	6	4	196	11	8	609													100
0.91	9	7	186	15	11	580													110
0.83	13	10	178	20	15	553	28	22	1225										120
0.77	18	14	170	25	20	530	33	27	1175										130
0.71	23	18	164	31	25	510	38	32	1129	39	2081								140
0.67	30	24	158	36	30	492	43	36	1089	44	2007								150
0.63	35	30	152	41	35	475	49	41	1053	49	1941	58	3188						160
0.56	48	41	143	52	45	446	61	52	989	61	1825	71	3000						180
0.50	65	56	135	66	57	422	76	65	936	75	1727	86	2839	98	4313				200
0.45	89	77	128	83	71	401	92	79	890	90	1642	103	2703	116	4104				220
0.40	204	176	119	113	97	374	120	105	832	117	1536	131	2527	146	3840	163	5511		250
0.33				186	161	339	184	159	755	172	1395	188	2296	207	3492	227	5013		300
0.29				324	283	312	269	234	695	242	1287	259	2118	281	3222	305	4627		350
0.25							389	340	648	332	1199	347	1975	370	3006	396	4316		400
0.22							577	507	608	448	1120	585	1855	475	2826	504	4060		450
0.20							1175	1039	575	602	1066	747	1757	600	2674	628	3843		500
0.18										819	1013	953	1670	748	2544	773	3656		550
0.17		Normal Flattest grade be adopted								1191	967	1226	1596	926	2430	940	3494		600
0.15		in reticulation design - - - - -										1630	1531	1138	2331	1134	3351		650
0.14												2829	1471	1400	2242	1362	3222		700
0.13													1420	1732	2162	1628	3109		750
0.13		Absolute limiting grade for pipeline												2186	2089	1948	3006		800
0.12		designed to be cleaned by gravity												2925	2024	2341	2926		850
0.11		flows ———														2850	2825		900
0.10																5668	2673		1000

Adapted from the "Manual of Practice: Sewer Design", Public Works Department, NSW

5.6 Rising mains and pumping stations

The designer shall take into account access, site maintenance and restoration, easements, power supply and working area when locating pump stations in road reserves or on public property. The City shall approve the location of any pump station.

Where not provided as a vacuum sewerage system, the designer shall provide for all pump stations to be of single wet well submersible pump style within self contained freestanding switchboards suitable for external use.

Velocity in the rising main should not exceed 3.0 metres per second and be a minimum of 0.7 metres per second, unless directed otherwise by the City

5.6.1 Design flows

The design flows should be calculated in accordance with Appendix C of WSA 02-2014. The following parameters shall be adopted:

- The Leakage Severity Coefficient shall be C=1.6, unless directed otherwise by the City.
- Design rainfall is the 1 hour duration rainfall intensity for a (50% AEP) ($I_{1,50\%}$) and shall be:

Location	$I_{1,50\%}$ (mm)
Coffs Harbour	43.2
Sapphire Beach	43.2
Moonee Beach	43.0
Emerald Beach	42.8
Woolgoolga	42.7

- The "peaking factor" (d) shall be:
  $d = 0.01(\log_{10}EP)^4 - 0.259(\log_{10}EP)^3 + 2.56(\log_{10}EP)^2 - 11.37(\log_{10}EP) + 20.78$
  [Note, this is in accordance with the Gravity Sewerage Code of Australia, Regional New South Wales Edition, Version 1, *Water Services Association of Australia*.]

5.6.2 Rising main materials

Rising main pipelines and fittings may be of any of the following materials manufactured in accordance with the relevant Standards,

- O-PVC Series 2 PN16 in accordance with AS/NZS 4441;
- PN16 or SDR11 HDPE in accordance with AS/NZS 4130;
- Rising mains at road crossings with cover less than 1200mm or creek crossings shall be DICL PN35 pipe such as Tyton Extreme or approved equivalent. Where high points are introduced in the line, Calcium Aluminate (CA) lining of the DICL pipe shall be provided; and
- An alternative material at aerial pipe crossings may Mild Steel Cement Lined (MSCL) CA lined pipe in accordance with AS 1579. Proprietary products such as sintakote or approved equivalent may be used.

All rising mains must be constructed from material which is compatible with Ductile Iron fittings.

All cast or ductile iron fittings should be cement or epoxy lined and conform to AS/NZS 2544 and AS/NZS 2280 respectively. Stop valves and scour valves are to be clockwise closing (CC) and resilient seated, with stop valves to have a minimum pressure rating of Class 16.

Where the rising main is located outside of built up areas, concrete markers posts shall be provided at changes in direction. The marker posts shall be painted “Brunswick Green”.

5.6.3 Valves, fittings and vents

Each pump discharge line is to be provided with a reflux valve and stop valve; the stop valve is to be positioned upstream from the reflux valve.

An approved air valve is required at high points in the main.

A scour valve, line and pump out chamber is required to enable the rising main to be completely drained of sewage in accordance with the City Standard Drawing 500 series.

The receiving maintenance hole is to be vented and lined with a protective coating that is suitable to resist attack from H_2S. The sewer rising main entry and exit from the chamber shall be in line rather than introducing an internal angle within the chamber.

The developer is required to submit detailed drawings of rising mains and receiving maintenance holes for approval.

5.6.4 Pumping stations

The Designer shall size pipes and pump station capacity to avoid surcharges under design flow conditions. The Designer shall provide for overflows in strict accordance with the conditions of the licence, if any, permitting sewage overflow.

Wet well capacity is to be sufficient for a minimum of 4 hours of Average Dry Weather Flows (ADWF). Where the catchment is within the boundary of the Solitary Islands Marine Park, the capacity shall be a minimum of 8 hours of ADWF.

Pumps are to be sized for a maximum 10 starts per hour and provide a self cleansing velocity of 0.7 metres per second in the rising main. Full stand-by pump capacity is required.

Minimum volume from top water level to bottom water level is to be the volume pumped in 90 seconds.

The detention time in the rising main should not exceed 4 hours.

All incoming lines to a pump station are to be fitted with a knife type isolation valve at the end of the incoming line.

Site access and hardstand areas for vehicle turnaround shall be designed to accommodate the swept path of a Class 3 two axle truck (standard fitters truck).

5.6.5 Surfaces

The Designer shall provide for internal surfaces of wet wells to be prepared and coated with an epoxy paint system approved by the Superintendent. All bolted connections within wet wells shall be stainless steel complying with AS 2837 Grade 316.

5.6.6 Protection against flooding

Where the pump station site is exposed to possible flooding, the Designer shall provide for the top of pump well to be one (1) metre above the 1% AEP flood level or to such other level as provided by the City's planning instruments, whichever is the higher.

5.6.7 Protection against floatation

The Designer shall provide for the design of pump wells against flotation both during the construction and installation stage and whilst operating under flood conditions designed as above.

5.6.8 Pumps

The Designer shall specify special requirements, if any, for materials to be used in the pump station, taking into consideration the nature and composition of the sewage to be pumped. Each pump shall be fitted with a flushing valve installed in accordance with the manufacturer's recommendations.

The Designer shall provide for pump stations to be fitted with suitably sized pumps, consistent with other pumps in service, in conventional duty pump/standby pump arrangement.

Each pump shall be capable of passing solids of not less than 75 mm diameter unless grinding equipment is incorporated

Each pump shall be capable of being removed with the aid of fixed guide rails.

Pump sets are to be interchangeable within each pump station.

The Designer shall design structural steelwork in accordance with AS 4100.

5.6.9 Electrical

The pump station shall be designed for fully automatic operation in the unmanned condition.

Where more than one (1) item of equipment is designed to form a particular function, all such items of equipment shall be identical and completely interchangeable (eg. pilot lights, pushbuttons, relays, etc.).

The switchboard shall be in accordance with the City's standard series supplied by City Smart Solutions. Switchboards shall be installed in visibly and physically accessible above areas at risk of flooding.

Ambient conditions shall be within the normally accepted limits of 0°C to 45°C.

The switchboard shall be connected to the local electricity supply system. Nominal system parameters:

- 415 volt, 3-phase, 4-wire, 50 Hz, solidly earthed neutral system; and
- Prospective Fault Current: as specified by Essential Energy.

5.6.10 Water Supply

The Designer shall provide for automatic well washers and flush valves to be installed at each pump station and controlled so that they operate when the duty pump is operating.

The Designer shall provide at all pump stations for an adequate water supply for cleaning purposes. This supply shall be protected from contamination due to backflow by the installation of a registered break tank or reduced pressure zone device in accordance with AS 3500.2.

5.6.11 Telemetry

The Designer shall provide for telemetry requirements in accordance with the schedule supplied by the City. The telemetry system is to be compatible with the existing system, if any, in use.

5.7 APPENDIX A – Checklist - Sewer design

Item No.	Description	Reference	Developer confirmation	City confirmation	Comments
1	Sewer servicing strategy	5.4.2			
2	Excavation or building adjacent to or over existing sewer mains	5.4.5			
3	Pumping stations and rising mains	5.6			
4	Maximum and minimum allowable loadings – reticulation mains	Table 5-E & 5.5.9.3			
5	Low pressure sewer pump units residential property system – advice for developers	5.9			
6	Design departure application and approval documentation	1.6			

5.8 APPENDIX B – Information to be shown on sewer reticulation drawings

Item No.	Item Description	Developer confirmation	City confirmation	Notes/comments
1	**General**			
1a	Cover sheet with locality plan, list of drawings and DA number			
1b	Plans prepared in A1 format at a scale of 1:500			
1c	Drawing scale is shown on drawings as a bar scale			
1d	Scale of detail drawings is shown as appropriate			
1e	Schedule of symbols			
1f	Benchmark within 100 metres of development site is shown			
1g	North Point shown			
1h	Site topography is shown via contour lines			
1i	Datum reference including benchmark at AHD adopted by NSW Department of Lands			
1j	Each plan to be numbered with revision no. and revision schedule if required			
1k	Road names or number			
1l	Drawings to be signed by respective consultant / engineer			
1m	Lettering, line work and symbols to conform to AS 1100			
1n	Sewer mains to be shown on cross sections			
1o	Each plan to be numbered with revision no. and revision schedule and revision date, with a cloud around revisions with a revision no.			

Item No.	Item Description	Developer confirmation	City confirmation	Notes/comments
2	**Sewer layout plans**			
2a	Catchment area plan including sub-catchments and areas is submitted			
2b	Existing sewer mains, junctions, side lines and manholes are shown			
2c	Lot boundaries and numbers shown			
2d	Sewer main lines and manholes are numbered			
2e	Pipeline centreline chainages are shown			
2f	Pipeline diameters are shown			
2g	Dead end length to conform with the Technical Guideline			
2h	Side lines to conform with the Technical Guideline			
2i	Type and class of pipe work and fittings clearly indicated			
2j	Alignment of mains, side lines, junctions, dead ends, manholes etc. to be shown			
2k	Location of mains etc. in accordance with respective footway allocations for urban and rural residential to be shown			
2l	Location of proposed easements reserves etc. incl. downstream if required			
2m	Location of all drainage lines, water mains and other utility lines crossing the mains to be shown			
2n	Limit of construction to be shown including staging			
2o	Mains to be extended to the full length of the subdivision			

Item No.	Item Description	Developer confirmation	City confirmation	Notes/comments
2p	Junction to each block slope type if main is within property, square type if main is external to property			
2q	Spot levels as necessary at the lot extremities to show that the whole of the lot can be sewered			
2r	Manhole spacing to be in accordance with maximum spacing according to main size			
2s	Rising mains to be shown with appropriate details according to the Technical Guideline			
3	**Sewer longitudinal sections**			
	Setout to conform to the City standard drawing for long sections			
3a	Sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
3b	Levels to be shown at 20m chainage intervals, manhole locations, dead-ends for gravity mains and high and low points for rising mains			
3c	Chainages as per layout plans			
3d	RL of existing surface, design surface and pipe invert at each location of 3b above and at major variations in natural surface such as roads, gullies etc.			
3e	Design RL of all inlet and outlets at each manhole and all changes of grade			
3f	Design grades including length of each gradient between manholes			
3g	Pipe diameters and material type and class to be shown			
3h	Air valves and scour valves on rising mains at respective low and high points			

Item No.	Item Description	Developer confirmation	City confirmation	Notes/comments
3i	Minimum cover requirements have been achieved			
3j	Location and size of existing and proposed services and utilities crossing the main complete with invert levels			
3k	Sections to be taken along intersecting roads for a sufficient distance to allow connection design			
3l	Trench stops shown as required on steep grades			
4	**Miscellaneous**			
4a	Design is satisfactory for future extension			
4b	Pipe sizes and design conform to current strategies for future development			
4c	Detailed engineering drawings are required for any rising main structures such as pumping stations and specialised manholes and vents proposed for construction in conjunction with sewer supply works			
4d	Sufficient capacity in downstream reticulation system to cater for development			
4e	Engineering plans and subdivision plans agree			
4f	Engineering conditions of consent included in design plans			
4g	Junctions to each lot to comply with the soffit requirements in accordance with NSW Code of Practice for Plumbing and Drainage 2006			
4h	Mains to be designed to satisfy minimum cover requirements			
4i	Minimum pipe size is 150mm diameter			

Item No.	Item Description	Developer confirmation	City confirmation	Notes/comments
4j	Pressure sewer designed in accordance with WSA guidelines			
4k	All details conform to standard drawings including twin lift sewer manhole covers, drop structures, junction thrust restraints and trench design			

5.9 APPENDIX C – Low pressure sewer - residential property system – advice for developers

For the information of Developers the following additional information is provided in relation to on property installation of low pressure sewer pump units.

OWNERSHIP OF THE UNITS

The ownership of the units will reside with the City and includes the following:

- Pump;
- Storage vessel;
- Ancillary fittings;
- Property delivery line/s;
- Control panel; and
- Boundary kit.

City ownership terminates at the first flexible joint on the inlet side to the pressure sewerage storage vessel.

In general the City will not seek to take out an easement over any part of the installation. The City reserves the right to create an easement if required on a particular property to ensure the safe ongoing operation of the system, the minimisation of any health concerns or the protection of City property.

SUPPLY AND MAINTENANCE OF THE UNIT

The City will supply and maintain the following components where a pressure sewerage system is to be installed:

- The storage vessel;
- Pump;
- Ancillary fittings;
- Control panel;
- Boundary kit;
- Valves (On Property); and
- Stand for control panel, where required.

STANDARD INSTALLATION PARAMETERS

A standard installation includes the provision of:

- One pump and tank;
- 40m of pipework from the boundary kit to the tank;
- The tank is to be located within 10m of the main building contributing the majority of the flow; and

- Connection of pools or spas with a capacity less than 250L.

All additional costs for items outside of the above parameters are to be met by the property owner.

PROPERTY INSTALLATION

The following will be required for pump/tank installation:

- The individual property owner must provide to the City six weeks notice to arrange the installation of the pump/tank units;
- The pump/tank units are only to be installed after storm water and sewer main lines have been constructed;
- The location of the pump/tank unit will be determined in consultation with the property owner; and
- The installation will be subject to the owner entering into a Maintenance Agreement with the City. Connection to the City's sewer system will not be approved until such an Agreement is entered into. Continued connection is conditional upon continuing such a Maintenance Agreement.

MAINTENANCE AGREEMENT

Every property owner will be required to enter into a formal maintenance agreement with the City as a precondition to being connected to the City's reticulation system. Such an agreement will set out what is expected of both parties.

This is a separate stand alone document.

OPERATION OF THE PUMPING UNIT

Pumping units operate automatically and do not require any specific input from the property owner. In relation to the overall operation of the pumping unit the following will apply:

- The property owner will meet the individual power costs.
- The City will meet all operational costs.

ON PROPERTY DESIGN

The design limits for the on property works will be from the outlet of the boundary kit to the inlet to the pumping station (i.e. the household drainage inlet). The standard design will include:

- Installation of the pumping station (pump unit);
- Electrical connections;
- Construction of the property delivery line;
- All restoration; and
- Making the pump accessible.

The City requires the property owner's written consent with the "on-property" layout design before commencing the installation. Where possible the property owner's reasonable needs will be accommodated.

STANDARDS AND REGULATIONS

All designs will be carried out in accordance with the WSAA Pressure Sewerage Code of Australia and the relevant Australian Standards. If those carrying out the design believe there is any conflict then these matters should be raised with the nominated Group lead.

PUMP DUTY POINTS

The pump supplied is capable of meeting the following duty points.

Head = 40m

Flowrate = 0.45l/s

The 40m head should be taken as the maximum head the pump is designed to accommodate (i.e. the total static head plus the friction losses that will occur in the designed reticulation system).

The flow rate of 0.45l/s is the minimum flow rate the pump should be capable of discharging under normal operating requirements. Higher flowrates are permissible.

NUMBER OF PUMP UNITS PER PROPERTY

A single pumping unit is to be provided for each residential property. Other alternatives will be investigated if a single pumping unit is not appropriate for the application.

PUMPING UNIT STORAGE VESSEL SIZE

The pumping station supplied will have:

Minimum Effective Storage - 600 Litres; or

Minimum Emergency Storage - 400 Litres.

INSTALLATION OF PUMP STORAGE VESSEL

The following steps need to be applied in relation to all pumping station installations in Coffs Harbour

- The pumping station should be installed as close as practical to the building contributing the majority of flow contributions on the property;
- The pumping station is not to be installed in a ground depression, where rainfall runoff water would normally pond;
- The pumping station must be installed within direct line of sight of the pressure sewerage control panel;
- A concrete ring beam is to be poured around the base of the storage vessel. The size of the ring beam will be in accordance with the Technology Suppliers requirements; and
- Excavation holes for the pumping station are not to be left open overnight.

VENTING

Where the 1% AEP flood level impacts the property, the venting of the pumping station is to be provided to a minimum of 500mm above the designated flood level.

HYDRAULIC CONNECTIONS

The lines need to be flushed to ensure no construction debris is in the lines before connecting to the pumping station.

The homes plumbing is to be tested in accordance with the NCC Volume Three Plumbing Code of Australia prior to connection to the pumping station. The plumber will then need to attest in the supporting document that the house lines meet this requirement.

An overflow relief gully is required in accordance with the NCC Volume Three Plumbing Code of Australia, to prevent internal overflows. This is to be included by the property owner's plumber, and must not be covered once the pump is operational.

INLETS AND OUTLETS

Pipe connections to the tank should be capable of being made without leakage through the joints. The pumping station should be supplied with appropriate sealing devices for these connections.

On the inlet side a short length of pipe should be extended to connect the household drainage lines. On the outlet side the internal pipework should be extended a short distance (minimum 1.0 metre length) beyond the pumping station to connect the property delivery line.

RESIDENTIAL PIPE MATERIALS

The property delivery lines for all Coffs Harbour applications will be:

- 32mm internal diameter polyethylene pipe;
- Pipe Class PN12.5; and
- Where possible the pipe should be purchased in long rolls to minimise the number of joins required.

PIPE COLOURS

Cream striped black polyethylene pipe is to be used for pressure sewerage systems in accordance with WSA PS – 207S.

JOINING THE PIPES

All pipes are to be joined by electro fusion or butt thermal fusion techniques in accordance with the manufacturer's requirements. Those carrying out the pipe joins are to be appropriately qualified, capable of demonstrating their experience with this technique and have the right equipment to affect the welds. The City will also consider butt welding of the pipes by persons with the appropriate qualifications, equipment and experience.

DEPTH AND LOCATION OF PIPEWORK

The property delivery line is to be connected to the boundary kit located at the low side of the front boundary. All pipelines are to be laid approximately 1.0m from the boundary and run

parallel, to that boundary. Where the properties are large and this requirement is unreasonable, it will be laid in a position as agreed with the property owner.

The pipe will be laid to a depth where there is a minimum 450mm of cover over the pipeline in areas with no vehicular loading and a minimum cover of 600mm in areas with vehicular loading.

The pipe can in most instances simply be backfilled with the excavated material where the trench has been dug by a trenching machine such as a ditch witch. This assumes that the main is excavated in what are all soil conditions.

Where rock or gravel is encountered in the trench or in some circumstances where there are a large number of timber pieces that might puncture the pipe then the pipe is to have a minimum of 50 mm of sand backfilling on all sides. Where sand fill is required, the trench is to be excavated an additional 50 mm with the pipe to be laid on top of this sand bed. The trench excavation will need to be wide enough to allow for the sand filling around the pipe.

Where it is difficult to gain the depth due to excavation difficulties, then the pipe is to be encased in a minimum of 100 mm of concrete. The trench will need to be widened to accommodate this encasement.

Appropriate service separation is required to ensure minimum risk to the pipework if and when services require excavation for maintenance or replacement

MARKING THE PIPES

The locations of pressure sewerage pipes are to be marked in the following manner:

- Tracer wire, (capable of being energised) is to be laid in the trench for both the reticulation and residential pipe materials;
- Pipes are to be laid at the standard depth. Where the main is laid at depths greater than 600mm, this will be marked clearly on the plan; and
- A beige or cream coloured marker tape is to be laid 300mm above the top of the pipe. This marker tape should indicate that there is a pressure sewerage system below it.

CONTROL PANEL INSTALLATION

All electrical connections are to be carried out in accordance with AS 3000 and must be carried out by an appropriately qualified electrician.

In affixing the control panel to the building, the Installer and electrician are to:

- Ascertain the 1% AEP flood levels for the property and ensure that the bottom of the control panel is a minimum of 500mm above the level designated;
- Ascertain the local electrical supplier requirements and ensure that Installers Staff always meets those requirements;
- Ensure that the control panel and the pumping station always remain within an easy line of site of the pump storage vessel; and
- Affix the contact numbers sticker when the installation is completed.

The Control panel is to be generally mounted on the dwelling wall. Where the pumping station is to be installed away from the dwelling a stand-alone post (fit for the purpose) and as supplied by the Technology Supplier may be used.

SPA'S

The City requires that any installation of a spa include a device to regulate the discharge to prevent system alarms or overflows from the pressure sewerage system. Each installation will be determined on a case by case basis with formal approval required by the City.

The costs for any additional equipment that is required to be installed to accommodate large sudden discharges will be met by the property owner.

In general:

Spa's with less than 250 litres in normal operating volume: Require that no special provisions are made and as such they can be treated as a standard household water-using appliance.

Spas between 250 litres and 700 litres capacity in normal operating volume: Require some additional measures be fitted to the pressure system to avoid system alarms. Typically these could involve the following and will be dealt with on a case by case basis, with the property owner to be advised by the City on what is the preferred option.

- Time delays to the alarm switch.
- Restricting the discharge rate of the Spa into the pressure unit.

Spas with a normal operating volume in excess of 700 litres: Require that differing flow restriction devices be added to the system. Typically these will involve the following and will be dealt with on a case by case basis, with the property owner to be advised by the City on what is the preferred option:

- Providing some form of upstream storage with a limited discharge rate to more closely match that of the pressure sewerage unit.
- Time delays on the alarm.

Spas with a backwash facility: Will be dealt with the same as for a swimming pool.

SWIMMING POOLS

The City requires that any installation of a swimming pool include a device to regulate pool backwash volumes and rates, to prevent system alarms or overflows from the pressure sewerage system. Each installation will be determined on a case by case basis with formal approval of the City required.

The costs for any additional equipment that is required to be installed to accommodate large sudden discharges will be met by the property owner.

In general:

Pools with a backwash pump up to 0.45l/s: Require some additional measures be fitted to the pressure system to avoid system alarms. Typically these could involve the following and will be dealt with on a case by case basis, with the property owner to be advised by the City on what is the preferred option.

- Time delays to the alarm switch; or
- Restricting the discharge rate of the pool into the pressure unit.

Pools with a backwash pump that exceeds 0.45l/s: An additional storage with a controlled discharge of less than 0.45l/s will be placed between the pool's discharge pump and the sewerage pumping station unless the pool pumps discharge can be regulated to below 0.45l/s.

PLANS

Following the initial meeting with the property owner, the Designer is to prepare a plan of the proposed on property design. This plan at minimum must show the following:

- Location of the pumping station, relative to the buildings, including tie lengths to any suitable reference points;
- The pipeline route, including ties at any change of direction;
- The location of the boundary kit;
- The point of connection to the City reticulation mains, where the main is on the same side as the property;
- The location of the overflow relief gully;
- Any proposed under boring; and
- Any unique features of the property, which have impacted the design such as gardens, structures, etc.

The layout plan is to be in plan view only as it will be assumed the property main will be minimum depth. Where this is incorrect the plan view will show the locations, where the depth has varied. Details of the depth at the start of the deviation, as well as at 2m intervals along the deviation will be required.

It is intended that the property layout plan will become the property Work as Executed drawing, provided that there are not too many changes to the layout. It should also be in an electronic format compatible with the City's GIS system.

CONSTRUCTION REQUIREMENTS – THE CITY TO INSTALL

The City will undertake or arrange installation of all units.

HOMEOWNERS MANUAL

The City will provide homeowners' manuals, which provides basic instructions on how to use the pressure sewerage system. It also provides basic instructions on what to do if an alarm is activated.

PART 6

TECHNICAL GUIDELINE

FOR

LANDSCAPING

6 Technical guideline for landscaping

6.1 Introduction and objectives

This section of the Technical Guidelines outlines the City's recommended practice for landscaping, including street tree planting. It is in no way a comprehensive design "Manual" and it is intended to be read in conjunction with and as a supplement to the following:

- The Coffs Harbour Public Realm Strategy; and
- The Coffs Harbour Public Realm Urban Design Guidelines.

The design of landscaping shall be based on best practise engineering standards and shall meet or exceed the requirements of these Guidelines as well as relevant sections of Standards and publications referenced herein.

The design of landscaping should be undertaken with consideration of the design of other services including those nominated in the sections listed below:

Part 1 General Requirements

Part 2 Technical Guideline for Roads

Part 3 Technical Guideline for Design of Stormwater Drainage and WSUD

Part 4 Technical Guideline for Design of Water Reticulation

Part 5 Technical Guideline for Design of Sewerage Reticulation

Part 7 Technical Guideline for Bulk Earthworks and Retaining Walls

6.2 Public reserves

The City uses a hierarchy to classify all its open space areas and parks. This hierarchy gives clear guidance to the level of development and maintenance standards.

The City staff will classify the open space or park prior to any design work for a public reserve.

6.3 Hierarchy of parks

The Hierarchy of open space that typically gets enhanced with infrastructure and recreational amenity includes the following categories:

- Regional Parks;
- District Parks;
- Local Parks
- Linear Park; and
- Natural areas

The hierarchy determines the level to which a parcel of open space can be developed. Table 6-A outlines the hierarchy levels and what the desired standard of development within the categories.

Detention and retention basins will not be accepted as public open space for the purpose of recreation.

Table 6-A – Hierarchy of parks

Park Category	Description / Service	Approx Size	Possible facilities
Regional	Regional parks attract visitors from across the Coffs Harbour LGA. They are significant and unique public open spaces that are highly accessible to the community Regional parks cater for large groups of people and provide for a variety of destination recreational activities whilst simultaneously protecting high conservation values. They provide long stay bespoke facilities with strong connections to the City's active transport network. The design focus should be on key landscape features such as the harbour estuaries or central reserves.	> 5 Hectares	Designated car parking Connection to the City's active transport network Destination inclusive all age play equipment Accessible play equipment Picnic facilities Large outdoor spaces for group gatherings Consideration of aboriginal cultural heritage values Quality and substantial park furniture Lighting/power Visitor facilities and amenities Trail and path network through the park Large shade trees to maximise natural shade and frame views Attractive landscaping / gardens
District	District parks are typically located within a 25 minute walk (or 2 kilometres) of residential areas and service multiple neighbourhoods and provide facilities and features that cater for a range of age groups, ensuring everyone can play and stay. The play and recreational opportunities are to be of a higher standard than for a local park and must focus on inclusive, multifunctional destination play opportunities. District Park shall be linked to the public open space network by connecting them to local parks and	2 to 5 Hectares	Inclusive play equipment Connection to the City's active transport network to minimise the need for parking Active youth facilities Relaxation areas Picnic facilities Consideration of aboriginal cultural heritage values Visitor facilities and amenities Large shade trees to maximise natural shade

	linear parks via an active transport network. 50% of the site has road frontage for access and visual surveillance		Attractive landscaping / gardens
Linear	Linear parks are smaller, often thin and continuous areas of open space that don't meet the performance definitions of other public realm typologies. They are primary connectors and play a significant role in moving people through the City's open space network and are typically made up of natural areas and active transport links. The connection within linear parks is both physical and visual and promote a pedestrian friendly active environment and support natural systems	No minimum area	Path with suitable width and material to accommodate cyclists and pedestrians Clear sight lines along active transport links 50% to 80% shade tree canopy for user comfort No amenities Seating options Supports natural systems
Local	Local parks service the need of the immediate resident population and provide spaces for small recreational games in a simple and responsive manner. 50% of the site has road frontage for access and visual surveillance To achieve this goal, these parks allow for informal recreational activities on open grassed areas (eg soccer or football) or hardstand areas (eg basketball or handball). Refer to the public realm strategy for the occasions where playgrounds may be omitted from a local park. Footpath and bike infrastructure typically connect local parks to other open space areas Local parks are maintained to a minor service level with minimal future embellishment.	5,000m^2 to 7,000m^2 in low and medium density zoning 1,500m^2 to 3,000m^2 in high density areas	Park seat Small grassed or hardstand area for recreational activities Limited planting of trees / shrubs

Natural Area	Compromise high conservation value vegetation and high conservation value land managed by or on behalf of the City of Coffs Harbour Natural areas play a key role in protecting and enhancing habitats, hold unique features of our favourite places and help establish and strengthen visual and physical connections throughout the public realm. The natural area is the primary contributor to our blue links (waterways) and green links (vegetation corridors)	No minimum area	Connect people to nature Provide buffers to adjoining public realm types to protect ecological sensitivities Create opportunities for habitat and habitat links

Further information about the hierarchy, function and facilities used at the different parks and public realm areas are is provided in the City's Public Realm Strategy and Public Realm Urban Design Guideline.

6.4 Public open space development process

The process for the development of public open space is as follows:

1. The Developer shall prepare and submit for approval a landscape master plan and relevant management plans;
2. The Developer shall prepare and submit for approval detailed landscape drawings prior to construction at the time of submitting civil design drawings;
3. Construction can commence only upon approval of the detailed landscape plans;
4. On completion of the works, the Developer shall arrange a practical completion inspection;
5. The Developer is required to maintain the Public Open Space reserve for a two year period from practical completion;
6. Three months prior to the expiration of the maintenance period, the Developer shall contact the City to initiate the handover process, which shall commence with a joint inspection of the Public Open Space; and
7. Once the City is satisfied the Public Open Space meets the Standards herein, the City shall accept responsibility for maintenance of the Public Open Space.

6.5 Landscape masterplan

The landscape masterplan is to be submitted for approval in principle prior to the submission of detailed landscape drawings.

The landscape master plan shall include:

- A detailed feature and contour survey;
- Location of public open space with respect to the boundaries of the development;
- Boundaries of the Public Open Space;
- Naming of reserves in accordance with the City's Reserve Naming and Memorial Policy;
- Landscape theme (If any);
- Adjoining land uses (road, private lots etc.);

- Areas of natural vegetation to be retained;
- Areas of natural vegetation to be cleared;
- Wetland areas to be protected;
- Drainage functions including drainage infrastructure;
- 10% AEPand 1% AEP flood water levels where applicable;
- Areas to be planted/grassed;
- Pathway alignments;
- Playground locations;
- Location of any structures (pergolas, amenities, barbecues, etc.);
- Entry statement location and conceptual design;
- Fencing;
- Reticulation;
- Proposed contours (including retaining walls);
- Maintenance program including supplier details for playground equipment and cost to undertake the reoccurring maintenance for the City review; and
- Areas allocated for public open space shall not be utilized for the purpose/function of drainage or stormwater retention or detention.

6.6 Public open space design & detailed landscaping drawings

Detailed landscaping drawings shall be submitted following in-principle approval of the landscape master plan. Three copies of the landscape plan, including any working drawings and associated landscape specifications should be provided addressing items listed in Appendix A**.** The design of elements within a park or playground shall be in accordance with this document and the City's Public Realm Strategy and Public Realm Urban Design Guideline.

Detailed landscape drawings shall include:

- Irrigation system and source of irrigation water;
- Bore licence information and bore construction details;
- Schedule of trees and other vegetation to be planted which indicates the botanic name (genus, species and cultivar), pot sizes and quantities;
- Trees, remnant vegetation or other site features being retained;
- Design and specification of play equipment;
- Seating and shelters;
- Barbecues;
- Disabled access facilities;
- Pedestrian and cyclist facilities;
- Signage;
- The location and specifications of bollards and vehicle control;
- Design contours;
- Retaining walls (will require engineer's certification depending upon the height); and
- Bill of quantities.

The following are minimum requirements for elements:

6.6.1 Amenities buildings

These structures shall meet the appropriate code. Be able to be locked and use an electronic locking system with back to base feature.

6.6.2 Barbeques

Barbeques shall be electric and be of a robust construction.

6.6.3 Bollards

The perimeter of any public open space that has frontage to a public road shall be fenced with vandal proof bollards to prevent vehicular access, subject to the City's approval. Posts shall be installed at maximum 1.8m centres. A gate or removable bollard shall be placed in a suitable location for vehicle access so that maintenance can be undertaken within the park.

6.6.4 Bridges

Bridges shall be designed and certified by an engineer. All products shall be durable with minimum design life of 50 years and slip resistant. The City will only accept Fibre Reinforced Polymer (FRP) or reinforced concrete bridges.

6.6.5 Furniture

Furniture shall be of a commercial design and durability and installed on concrete slabs which have plan dimensions of at least 0.5m larger on the rear edge and 1.0m larger on the front and side edges than the item of furniture being placed on it to reduce maintenance issues. Accessible furniture may be incorporated into the design in which case a larger slab may be required.

6.6.6 Gardens

Gardens shall be designed with the climate in mind and the responsible use of water and the use of mulch to reduce evaporation and weed growth. All gardens are to have provision for irrigation for watering purposes.

6.6.7 Irrigation

6.6.7.1 *Plans*

Plans of the proposed irrigation systems are to be submitted to the City prior to construction.

6.6.7.2 *Water supply - non potable*

Irrigation systems shall be typically run from potable water supply.

Developers shall cover all costs associated with the providing a water supply for irrigation of a park.

Where adopted, bores shall be a minimum of 150mm in diameter cased using either PVC in fractured rock and steel in Alluvial areas. Bores shall be either fully underground or installed within a small enclosure depending on their location within the landscape. Bore pumps shall be a variable speed drive with a screen over the inlet to prevent debris being pumped. The pressure transducer shall be installed within 1m of the mainline. A main ball valve and a hydrant point shall be installed adjacent to the bore water meter to allow flushing of the bore.

6.6.7.3 *Irrigation controller*

Irrigation systems shall be controlled with an electronic irrigation system with remote access for controlling the system with WiFi connection such as a Hunter ICC2 with Hydrawise or approved equivalent).

Where a bore is utilised, a Hunter HC Flow Meter – Flow Sync or approved equivalent shall be provided to measure water flow depending on which controller is used.

6.6.7.4 *Pipe works*

All irrigation shall be constructed using HDPE or uPVC pipe. Mainlines shall be a minimum of PN12.5 and lateral lines shall be a minimum of PN8.Trench depth.

Minimum cover over all irrigation pipe work shall be 350mm.

6.6.7.5 *Valves and valve boxes*

All solenoid valves shall be Hunter PGV or ICV or approved equivalent and have a ball valve to allow the line to be isolated. All valves shall be installed in a valve box with a minimum size of 420mm long x 305mm wide x 160mm deep.

6.6.7.6 *Sprinklers*

The use of popup sprinklers shall be discussed with the City during the design stage. Where provided, popup sprinklers are to be gear driven shafts. The height of the popup sprinkler shall be commensurate with the landscaping and irrigation design.

6.6.7.7 *Drip irrigation*

The use of drip irrigation in lieu of overhead sprinklers shall be determined on a case by case scenario, in consultation with the City.

6.6.7.8 *Operation and maintenance manual*

A manual detailing the automatic irrigation system shall be provided to the City prior to handover. The manual shall include the following:

- Introduction;
- Contact details;
- Sprinklers, risers and other emitters;
- Solenoid valves, value boxes, wiring, mainline isolation valves and air release valves;
- Controller;
- Poly pipes and fittings;
- Pump unit;
- Electrical works and services warranties, quality assurance and ‘as constructed’ drawings;
- Design parameters; and
- GPS location of the irrigation system in MGA2020 co-ordinate system.

6.6.8 Lighting

All pathway or security lighting shall utilise LED lighting.

6.6.9 Locks

Where locks are required (irrigation, electrical cabinets, gates, barbecues), the Developer shall provide locks keyed alike to the City ‘s Open Spaces key system.

6.6.10 Pathways

All pathways shall be either concrete to allow for wheelchair accessibility and a minimum of 1.5m wide.

Shared paths (cycle and pedestrian) in Public Open Space shall be a minimum of 2.5m wide and be constructed to the same specifications as for paths constructed in road reserves.

6.6.11 Playgrounds

All play equipment and fall zones shall comply with all relevant Australian Standards including but not limited to AS/NZS 4685, 4422 and 4486. Evidence in the form of an independent playground audit is to be provided to the City prior to Practical Completion.

All playgrounds shall meet the current Australian Standard and may use either organic mulch , rubber or sand as a soft-fall product with the appropriate certification. The type of soft fall shall be determined by the City on a case by case basis. A copy of the certification certificate shall be supplied to the City.

All playgrounds shall have consideration for shade. Playground located within local parks shall only utilise natural shade. Playgrounds in district or regional parks may use a combination of natural or constructed shade to ensure a minimum of 50 percent coverage. Where utilised, shade sails shall include anti climb devices and be located at an appropriate height to stop climbing or rubbing on the play equipment.

6.6.12 Power

Mains power shall be connected to parks if required to power amenities, irrigation, lighting or barbeques. The Developer shall be responsible for the power costs till such time as the park has been handed over to the City.

6.6.13 Rubbish Bins

Parks which fit into either Regional or District shall have at least 1 x 240L Mobile Garbage Bin (MGB) installed in an enclosure or on a bin stand. The provision of rubbish bins shall be in accordance with the City's Urban Design Guidelines and Public Realm Strategy.

6.6.14 Shelters

Shelters shall be of a commercial design and durability and shall be fixed onto concrete slabs to reduce maintenance issues. The dimensions of the concrete slab shall be 1.0m larger on each side than the shelter. A concrete pathway shall be provided to connect shelters with the park pathway system for connectivity. The provision of shelters shall be in accordance with the City's Urban Design Guidelines and Public Realm Strategy

6.6.15 Signage

All parks shall have a park name sign including the remote supervision and prohibited activities (the City shall provide information for the remote supervision and prohibited activities). All signage shall be consistent with the City's standard.

6.6.16 Turf

Parks and reserves shall be sprigged or solid turfed with a warm season turf species and appropriately watered and mown to promote establishment during the growth season. Periodic spraying for weeds shall be undertaken as required. The turf species shall be determined by the City.

6.6.17 Water - potable

District and Regional parks shall only be connected to potable water and local parks and linear parks may be connected depending on the availability of a potable water supply and at the discretion of the city. The Developer shall be responsible for the water costs until such time as the park has been handed over to the City.

6.6.18 Works As Executed plans

Works as Executed (WAE) plans shall be submitted prior to handover of the assets to the City. Completion acceptance shall not occur until such time as WAE plans are submitted. All documentation relating to WAE shall meet the requirements of the Works as Executed document.

6.6.19 Handover

The City shall only take handover of infrastructure if, at the time of handover, all integrated infrastructure works have been completed and are also due for handover.

6.7 Landscaping technical guideline for road verges

The developer shall prepare a comprehensive landscaping plan, which shall be approved by the City prior to issue of the Civil Works Certificate.

6.8 Planting details

At the pre-construction stage detailed planting information must be provided. A list of recommended tree species is listed within the City's Public Realm Urban Design Guidelines. The plan shall show the location and species name of the proposed plants in a key format that relates back to a plant schedule, the plant schedule shall have at least the following information:

- Botanical and common name relating back to the key name given;
- Number of plants to be used;
- Size of plant container;
- Growth rate;
- Mature growth height;
- Mature growth spread; and
- The expected size of plant to be planted at the time of planting.

The developer is also required to submit details of proposed maintenance programs of all landscaping elements and undertake to maintain all landscaping in sound health and condition until the expiry of the maintenance bond period. Prior to acceptance, the City will inspect the landscape works before signing off and accepting future maintenance responsibilities. During the maintenance period, horticultural best practices must be undertaken to ensure quality workmanship throughout the development before the City will accept the works.

6.9 Trees & Shrubs

Street trees shall be planted at a rate of 1 tree per 5-10 metres of road frontage. The developer must not plant their own trees without the approval of the City. Street trees are to be located in the footway within the road reserve and in accordance with the approved services locality plan. The works will be subject to a two-year maintenance period with a maintenance bond payable in accordance with Section 1.7.4. Planting shall only take place in favourable conditions, nominally spring or autumn. Planting street trees in lieu of payment to the City will not be approved if:

- level 3, 4 or 5 water restrictions prevail, or;
- the number of street trees in the stage is less than or equal to 10.

The theme of trees and shrubs to be planted shall be identified in the landscape plan and approved by the City based on criteria including that presented in the City's Public Realm Urban Design Guidelines:

- suitability to site conditions;.
- compatibility with existing vegetation; and
- planting themes for the locality.

Street trees with mature tree trunk diameter less than 150mm are considered to be frangible when assessing compliance with clear zone requirements.

Where the proposed street trees have a lateral root system or soil type that may cause the roots to spread at shallow depth to the ground surface, the City may direct the developer to install a proprietary root management system to divert roots downwards to a level where they can safely establish below ground level to protect the pavement and footpaths from root heave.

6.10 Road verges

The following conditions shall be satisfied prior to notification of completion;

- The ground surface of all road verges, parks and public reserves shall be of uniform grade and generally consistent with no obvious depressions and be free of boulders, foreign material and debris;
- All areas shall be trimmed as per the design contours in accordance with AS1428, to facilitate easy and safe mowing;
- Entrance statements not to be placed on public reserves or road verges;
- Existing vegetation, both above and below ground, that is located on road verges is to be protected from damage resulting, or likely to result from, from subdivision development works; and
- Existing vegetation located on road reserves that are deemed by the City to be dead or dangerous is to be removed or made safe by the Developer prior to date of handover.

6.11 Topsoil

On construction of disturbed sites, developers shall provide for topsoil to be stripped following the clearing of vegetation and stockpiled for re-use. Additional imported topsoil may be needed to establish vegetative cover on some hard or denuded sites.

The developer shall use topsoil stockpiled on site, where imported topsoil is required it shall comply with AS 4419 and shall;

i. Be of a friable, porous nature;
ii. Be free of weeds and weed seeds, bulbs, corms and vegetable propagules;
iii. Contain no refuse, contamination, or materials toxic to plant growth or human health;
iv. Contain no stumps, roots, clay lumps or stones larger than 50mm in size;
v. Have an organic content of at least 3 per cent by mass;
vi. Have a pH neither less than 5.5 nor more than 7.5;
vii. Have a soluble salt content not exceeding 0.06 per cent by mass; and
viii. The source of any imported topsoil shall be nominated and testing results shall be supply to the City.

Topsoil shall be uniformly applied to provide a minimum compacted thickness of 50mm. The topsoiled area shall be cultivated to a depth of 50mm to provide a roughened surface with soil lumps not exceeding 50mm dimension.

6.12 Roundabouts and median landscaping

Roundabout and median strip landscape design must have due regard for plant siting and maintenance requirements. Planting in roundabouts and medians are to be set back from the inside kerb edge as follows:

6.12.1 Roundabouts

Turf grass is not a suitable landscape item for roundabouts and will not be approved by the City. The following is a guide for landscaping of roundabouts.

- 0.0m to 3.0m setback: concrete apron slab;
- 3.0m to 5m setback: shrubs / native grasses /groundcovers only with a maximum mature unpruned height of 600mm above the road pavement (not top of kerb);

- >5.0m setback: trees and shrubs/ground covers. Roundabouts of 6.0m in diameter in low speed zones of 50km/h or less, a small single trunked tree with a mature diameter of 150mm may be located in the centre of the roundabout, providing such achieves a clear trunk height at planting of 1.5m above the road pavement level; and
- Turf is to be discouraged in roundabouts.

6.12.2 Median islands

Turf grass is not a suitable landscape item for median islands and will not be approved by the City. The following is a guide for landscaping of median islands.

- 0.0m to 0.3m: concrete apron slab;
- 0.3m to 1.5m setback: appropriate native grasses or ground covers, 200mm high, with minimal pruning requirements. Plantings should be setback sufficiently to avoid overhanging of the carriageway;
- > 1.5m setback: Trees / shrubs / ground covers only. Plantings should be setback sufficiently to avoid overhanging of the carriageway. Shrubs and ground covers to have a maximum maintained mature height of 900mm above the road pavement (not top of kerb). Trees are to be primarily single trunked species. Tree species chosen will depend on the species spatial requirements and clearance from service elements and light poles;
- Trees will generally not be planted in medians with an internal width less than 3.0m unless located in a speed zone of 50km/h or less and the tree species is selected so the canopy does not encroach into the road pavement;
- Trees may be located centrally or staggered provided such accords with traffic engineering visibility requirements. Tree species will be selected for appropriate canopy shape;
- Ends of median strips require special consideration and discussion with the City with regards to clear zones and safety requirements;
- Irrigation is to be placed in medians with subsoil drainage installed to adequately stop the ingress of water into the roadway. Irrigation shall be of such a design and quality of material and workmanship that the ingress of water into the pavement due to failure or damage is avoided;
- The root system of plants must not interfere with subsurface drainage and shall have root control system where necessary to protect City services (water and sewer) from root damage;
- The design shall minimise the requirements for maintenance;
- Interfaces between grass and areas of chip mulch are to be avoided. Where grass does interface with chip mulch, a concrete mowing strip of 300mm wide must be provided.

The mature unpruned height of under plantings on road verges or in roundabouts, medians and splitter islands is not to exceed 600mm above road surfaces. This height, however, may be reduced at the discretion of the City and may vary from site to site.

The type and extent of landscaping of medians shall be approved by the City.

6.13 APPENDIX A – Checklist – landscape plan

Item No.	Description	Reference	Developer confirmation	City confirmation	Comments
1	Detail boundaries, easements, fences, footpaths, gutter crossings, drainage and grassed areas. Services should be indicated on the plan and show at least, underground services (water, electricity, gas, telephone, sewer and stormwater);	6.6			
2	The location of overhead wires;				
3	Proposed surface materials including, turf, pathways, patios, mulched garden beds, etc. are to be shown and specified;				
4	All structures including existing and proposed building footprints and building F.L's are to be shown;				
5	Other landscape structures such as pergolas, gazebos, entry statements etc, with detailed documentation of how they are to be constructed, materials, colours etc;				
6	Fencing and retaining walls details and specifications;				
7	A contour plan showing all existing levels and proposed new levels;				
8	Lighting if applicable;				

9	Site furniture and play equipment, including type and colour;	6.6			
10	Details of edging treatment;				
11	Irrigation systems, including the location of the RPZ valve and the proposed location of the control box;		7.3.3		
12	Where the irrigation is to become part of the City's responsibility separate irrigation plans will need to be submitted for approvals by the City;				
13	Site drainage including any subsoil drainage and drainage pit locations.				
14	Each plan to be numbered with revision no. and revision schedule and revision date, with a cloud around revisions with a revision no.				

PART 7

TECHNICAL GUIDELINE

FOR

BULK EARTHWORKS AND

RETAINING WALL DESIGN

7 Technical guideline for bulk earthworks and retaining walls

7.1 Introduction and objectives

This section of the Technical Guideline outlines the minimum requirements for the design of bulk earthworks and site regrading and associated earth retaining structures in the Coffs Harbour LGA.

The principal design objective is to promote development in the Coffs Harbour LGA whilst ensuring the following:

- Create surfaces that minimise cut and fill;
- Create suitable lots upon which to build new dwellings or other structures;
- Create suitable surfaces for public infrastructure such as roads and parks; and
- Ensure public infrastructure is accessible and can be maintained safely and economically.

The design of bulk earthworks and earth retaining structures shall be based on best practise engineering standards and shall meet or exceed the requirements of these Standards as well as relevant sections of Standards and publications referenced herein.

The design of earthworks should be undertaken with consideration for the design of other services including those nominated in the sections listed below:

Part 1 General Requirements

Part 2 Technical Guideline for Design of Roads

Part 3 Technical Guideline for Design of Stormwater Drainage and WSUD

Part 4 Technical Guideline for Design of Water Reticulation

Part 5 Technical Guideline for Design of Sewerage Reticulation

Part 6 Technical Guideline for Landscaping

7.2 References

This Part should be read and utilised in combination with the following publications as referenced throughout:

- AS 1100 – Technical drawing
- AS 1289 – Method of testing soils for engineering purposes
- AS 1379 – Specification and manufacture of concrete
- AS 1428 – Design for Access and Mobility
- AS 2159 – Piling design and installation
- AS 3600 – Concrete structures
- AS 3700 – Masonry structures
- AS 4100 – Steel structures
- AS 3798 – Guidelines on earthworks for commercial and residential developments
- AS 4678 – Earth-retaining structures
- AS 4970 – Protection of trees on development sites
- Environment NSW - Assessing vibration: a technical guideline
- Managing Urban Stormwater - Soils and Construction Edition 4
- City of Coffs Harbour Construction Specifications
- City of Coffs Harbour suite of Standard Drawings

7.3 Bulk earthworks subdivision works certificate application documents

7.3.1 Design drawings

Design drawings shall be submitted to the City for approval. Information to be included in the design drawings is detailed in Appendix A

7.3.2 Design checklists

Each of the supporting items or documents listed in the checklists in Appendix B shall be completed and submitted with the Drawings. Should any of the items required in any checklist be outstanding or not to a standard acceptable to the City, the Drawings and checklists shall be returned to the Developer's Representative for amendment. The City shall only commence review of the design drawings once it is satisfied that all the requirements of the checklists have been met.

7.3.3 Bulk earthworks strategy

The general bulk earthworks strategy submitted with the application for development consent shall include the following as a minimum:

- Location of cut and fill greater than 300mm, including maximum cut and fill depths;
- Location and maximum heights of retaining walls;
- Location of major system overland flow paths;
- Analysis of topography, including natural drainage paths and watercourses;
- Consideration of flows from upstream developments and catchments, and consideration of the impact of the development on downstream developments and catchments;
- Location and type of any drainage diversion, retention or detention structures.

The City must be immediately informed of any variations to the bulk earthworks strategy that are identified during the detailed design phase.

7.3.4 Geotechnical report

A geotechnical consultant is to prepare a report if a SWC submission includes cutting or filling of land, The report must cover, but not be limited to:

- Extent and stability of proposed embankments (particularly those acting as detention basins);
- Recommended geotechnical testing requirements;
- Compaction specification for all fill within subdivisions;
- Requirements for drainage of embankments;
- Any works required for the filling of existing dams or watercourses;
- The impact of the installation of services on overall site stability and recommendations on short term drainage methods, shoring requirements and other remedial measures that may be appropriate during installation; and
- The level of risk to existing adjacent buildings or infrastructure from using vibratory rollers anywhere within the site the subject of the works. If vibratory rollers could affect adjacent buildings, high risk areas must be identified on the engineering drawings.

The certifying geotechnical engineer shall have a Level 1 responsibility in accordance with AS 3798 which is to be stated within the report, unless agreed otherwise by the City.

7.4 Bulk earthworks – general design criteria

Designers must consider how to minimise cut and fill on a development site to reduce overall impacts on the environment. A better solution to extensive cut and fill may be for designs to respond to the natural topography where possible to retain natural land features, trees, vegetation, and biodiversity.

This is to be balanced with the need to create flat sites for dwellings, new industrial buildings, and other building sites.

7.4.1 Allotment filling

Any proposed allotment filling on residential or commercial subdivisions or developments shall be shown on the drawings, including the location, quantity required and source material. Design surface levels are to be shown on construction plans.

All allotment filling shall be designed, constructed and tested as Structural Fill in accordance with Australian Standard AS 3798 – Guidelines for Earthworks for Residential and Commercial Developments.

Topsoil (as defined in AS 3798) is required to be removed during the works and re-instated following completion at minimum 100mm thick. Topsoil is not required to be included in lot filling declarations, provided this fill is less than 150mm thick.

The maximum grade of batters within a lot shall be maintainable and stable.

The finished surface level of any building area shall be designed to ensure a desirable surface grading of 1.5% (minimum 1.0%) orientated towards the drainage system for the lot. Where a proposed lot width at the future building line is less than 13m and retaining walls are proposed at subdivision stage, the fall across such a lot shall be between 0% and 1% orientated towards the drainage system for the lot.

Lots with building entitlement abutting the 1% AEP flood levels shall be regraded to achieve a minimum level of 0.5m above the 1% AEP flood level. In doing so, the designers shall ensure that other areas are then not affected by flooding for events up to the 1% AEP event.

Embellished public open space areas to be traversed by the public shall be no steeper than 6H in 1V and batters shall be shaped/undulating to reflect a natural landform.

All earth batters should have soft, feathered transitions. Tops, bottoms, and ends of cuttings should be rounded off.

Filled areas are not to create drainage patterns or flow volume or rates which adversely impact on downstream properties. Where this circumstance could occur, drainage systems are to be designed to intercept flows where necessary and convey to appropriate downstream systems.

Batters between development lots are to be wholly contained in the low side property with the top of the batter on the property boundary of the higher lot and the toe of the batter on the lower lot.

Revegetation with a suitable grass species is to be installed as soon as practicable after final levels have been reached and prior to final inspection for the Subdivision Certificate. The developer shall provide details of the proposed grass species to be used.

Erosion and sediment controls are to remain in place until revegetation is established over 80% of the area which has been revegetated.

7.5 Retaining walls - general design criteria

A Civil Works certificate regardless of whether a subdivision works certificate has been issued or not must be obtained for all retaining walls greater than 600 mm located on private property.

Proposed retaining walls on residential or commercial subdivisions or developments shall be shown on the drawings, including the top of wall, ground level and top of footing heights at changes in height or direction. Structural engineering drawings for retaining walls are to be provided with a structural design certification by an Accredited Professional for SWC submissions and subsequent certification following construction.

The design of retaining walls for strength and stability shall be in accordance with the Limit State design procedures in AS 4678 Earth Retaining Structures.

For cantilever retaining walls, the soil and water pressures shall be taken at the virtual rear of wall (i.e. at the rear of the footing) to properly consider the loading on the gravity wall.

Where retaining walls are in cut and clay soils are adopted for the backfill of the wall, a groundwater height equal to at least one half of the total retained height shall be adopted in the retaining wall design. The height of groundwater may be reduced to one third of the total retained height for fill walls with clay backfill or for walls in sandy material. Weepholes and subsoil drainage shall be provided in retaining walls regardless of the allowance for groundwater pressures.

The adopted soil design parameters and magnitude of the live load surcharge shall be specified on the drawings to ensure the construction is in accordance with the design assumptions.

Joints in walls and footings shall be provided as required to accommodate the shrinkage and thermal movements without excessive cracking in the structure.

7.5.1 Inter-allotment retaining walls

Inter-allotment retaining walls shall have a minimum design life of 50-years and structure classification B in accordance with AS 4678.

For all permanent inter-allotment retaining walls, materials are to be of natural cut stone, masonry, concrete or galvanised structural steel.

Inter-allotment retaining walls are to be located in the high side lot with a minimum distance of 50mm between the face of retaining wall and lot boundary. Where retaining walls are provided across several lots, the wall on a particular lot shall be structurally independent of any retaining wall on the adjacent lot.

Where required, retaining walls on rear boundaries in close proximity to the City's underground services shall be designed in accordance with the City's Policy "Construction in the vicinity of and protection of the City's underground assets policy", which prohibits construction over City assets.

Where inter-allotment retaining walls are provided, permanent fences are to be installed to prevent falls over retaining walls that are greater than or equal to 1m in height.

Granular backfill and drainage material is to be as specified by the designer. The drainage material shall be at least 300mm thick from the back of the retaining wall with a minimum 100mm diameter slotted flexible pipe (ag pipe) within a geofabric sock.

Retaining walls are to be designed so that permanent fencing attached to the wall acts with the retaining wall as an integrated structure, including for wind loading. Fixing details of fencing to retaining walls are to be provided in the design drawings and endorsed by an accredited professional.

Inter-allotment stormwater and sewer pipes shall be located a minimum clear distance of 300m from the backfill zone of retaining walls and the pipes shall be able to be excavated in the future for maintenance without affecting the stability of the wall.

The design of retaining walls on side boundaries shall consider instability caused by the excavation of service trenches on the lower lot. Alternatively, a restriction on use shall be created on the lower lot title adjacent to the retaining wall footprint, restricting excavation within the area burdened by the restriction. The width of the area and excavation restrictions within the area shall be determined by the retaining wall designer and shown on the design plans.

Where required, retaining walls on side boundaries in close proximity to the City's underground services shall be designed in accordance with the City's Policy "Construction in the vicinity of and protection of the City's underground assets policy", which prohibits construction over City assets.

7.5.2 Retaining walls (public assets)

The City maintains the right to refuse any proposed retaining wall which would result in it being a public asset.

All retaining wall designs submitted for review by the City must be accompanied by structural certificated from a suitably qualified and experienced engineer.

Design of retaining walls for streets, open space, drainage, industrial facilities and other non-residential inter-allotment purposes shall have a minimum design life of 100-year and structure classification B, or classification C in accordance with AS 4678, as nominated by the City.

For all permanent retaining walls in public spaces other than road reserves, materials are to be of natural cut stone, gabion baskets, masonry, concrete or galvanised structural steel. The City shall be consulted early so that aesthetic and functional objectives are satisfied by any proposed design.

The design of retaining walls shall consider instability caused by the excavation of trenches for existing or future infrastructure on the low side.

Granular backfill and drainage material is to be as specified by the designer. The drainage material shall be at least 300mm thick from the back of the retaining wall with a minimum 100mm diameter slotted flexible pipe (ag pipe) within a geofabric sock.

Services adjacent to retaining walls shall be located with a minimum clear distance of 300mm from the backfill zone of the retaining wall and the wall shall be located to allow the services to be excavated in the future without affecting the stability of the wall.

Minimum clearance between any part of the retaining wall (including backfill and footings) to infrastructure shall be the greater of 500mm or as nominated by the responsible authority.

7.6 APPENDIX A – Information to be shown on drawings – bulk earthworks and retaining walls

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
6)	**General**			
a)	Cover sheet with locality plan and list of drawings			
b)	Plans prepared in A1 format at a scale of 1:500			
c)	Drawing scale is shown on drawings as a bar scale			
d)	Scale of detail drawings is shown as appropriate			
e)	Schedule of symbols			
f)	Benchmark within 100 metres of development site is shown			
g)	North point shown			
h)	Site topography is shown via contour lines			
i)	Each plan to be numbered with revision no. and revision schedule and revision date, with a cloud around revisions with a revision no.			
7)	**Bulk earthworks plans**			
a)	Proposed site topography is shown via contour lines			
b)	Cut and fill depth is shown via a heat map			
c)	Lot boundaries and numbers shown			
d)	Direction and average grade of fall of each lot shown where cut or filled			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
e)	Location of all earth retaining structures shown with top and bottom heights			
f)	Location of discharge points for retaining wall drainage			
g)	Location and dimensions of any proposed easements or restrictions			
h)	Natural drainage paths are shown			
i)	Location of any retention or detention is shown			
8)	**Retaining wall longitudinal sections**			
a)	Longitudinal sections are drawn at scale of 1:500 horizontal and 1:100 vertical			
b)	Longitudinal section shows the following;			
i)	Chainages			
ii)	RL of existing surface at each change in height or direction			
iii)	Design RL of top of wall and ground level at regular intervals and changes in direction			
iv)	Footing levels at regular intervals and steps in footings			
v)	Location of existing and proposed services and utilities			
9)	**Miscellaneous**			

Item No.	Item description	Developer confirmation	City confirmation	Notes/comments
a)	Location and details of any batter catch-drains			
b)	Details of the type of vegetation to be used on batters			

7.7 APPENDIX B – Checklists – bulk earthworks and retaining walls

Item No.	Description	Reference	Developer confirmation	City confirmation	Comments
1	Bulk earthworks strategy including heat map and cut/fill balance	7.3.3			
2	Geotechnical report for proposed bulk earthworks and retention/detention structures	7.3.4			
3	Structural drawings of retaining walls are annexed to civil drawing set				
4	Structural certification of retaining walls to relevant standards including but not limited to AS 4678 and this document				
5	Batters within proposed lots are max 1V:6H within the building setback, or 1:1) otherwise	7.4.1			
6	Retaining wall shown where required on lots <13m wide	7.4.1			
7	Batters at lot boundaries to be contained to lower lot	7.4.1			
8	Retaining wall at boundaries to be contained to higher lot	7.4.1			
9	Retaining wall design has accounted for wind loads on attached fencing and service trenching on lower lot.				
10	Loads and assumptions used for retaining wall design to be included on the design plans	7.5			
11	Safety in Design report	1.5.2			

PART 8

Changelog

8 Document history and changelog

8.1 Introduction and document history

This section of the document outlines the City's history of technical guidelines. Any changes to the document will be captured as a new revision and the major changes listed within the changelog.

8.2 Changelog

This table details changes to the Guidelines as they have evolved to cater for changing Australian and industry standards and improvements nominated by the City and the local development industry.

Table 8-A – Technical guideline changelog

Version	Changes	Date
Version 1	Original issue	July 2024

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