BATHURST REGIONAL COUNCIL

GUIDELINES FOR ENGINEERING WORKS

Last Amended 21 October 2024

Signed: Darren Sturgiss – Director Engineering Services Date

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SECTION 7 – STORMWATER & SUBSOIL DRAINAGE 93

AMENDMENT RECORD

Proposals for amendment or addition to the contents of this manual shall be forwarded in writing to:

Director of Engineering Services
Bathurst Regional Council
Private Mail Bag 17
BATHURST NSW 2795

Amendments promulgated should be certified in the following table the manual is updated.

AMENDMENT			ENTERED
No.	DATE	DESCRIPTION	NAME
1	21/09/2023	Major revision of Engineering Guidelines released.	D. Sturgiss
1.1	21/10/2024	Requirements for works as executed information updated. *See Section 1, Clauses 6.4.2 & 6.4.3*	M. Coles
		Requirement for gas infrastructure to be provided as part of subdivision removed. *See Section 1, Clause 12.4*	
		Requirement to repair damaged service warning tape added. *See Section 1, Clause 27*	
		Requirements for inspections, testing, submissions and material requirements updated. *See Section 2 Clauses 3, 5, 6 & 7, Section 4 Clauses 10, 10.2 & 10.3, Section 5 Clauses 13, 13.2 & 13.3, Section 6 Clauses 11, 11.2 & 11.3, Section 7 Clauses 11, 11.2 & 11.4, Section 8 Clauses 6, 6.2 & 6.3, Section 9 Clauses 6, 6.2 & 6.3, Section 10 Clauses 4 & 4.3*	
		Grass mowing, maintenance and establishment details updated. *See Section 4, Clauses 4, 5, 6 & 7*	
		Requirements for provision of sloped headwalls to Council road reserve added. *See Section 6 Clause 6, Section 7 Clause 4.4.1.1 and Standard Drawing EN7881*	
		Requirements for pipe restraint & anchoring updated. Standard drawing *EN7895* renamed to “Pipe Anchoring and Concrete Bulkhead Details”. *See Section 7 Clauses 4.4.2.4, 4.4.6.3, 8.4.3 & 10.2.5, Section 8 Clause 5.2.5, Section 9 Clause 5.2.5 and Standard Drawings EN7895 & EN7905*	
		Requirement to provide building drainage connection stubs to interallotment pits at subdivision stage added. *See Section 7, Clause 8.4.2 & Standard Drawing EN7889*	
		Requirements for stormwater testing & survey updated. *See Section 7, Clause 11*	
		Requirements for tapping bands, main cocks & meter cocks updated. *See Section 8, Clause 4.6.3 & Standard Drawing EN7906*	

		Requirements for water covers & surrounds updated. *See Section 8, Clause 4.6.8 & Standard Drawing EN7907*	
		Requirements for stop valve spindles updated. *See Section 8, Clause 4.9 & Standard Drawing EN7903*	
		Requirements for sewer testing & survey updated. *See Section 9, Clause 6*	
		Pram ramp width details updated. *See Standard Drawing EN7877*	

SECTION 1 - GENERAL

1. INTRODUCTION

The Guidelines for Engineering Works have been developed to provide consistent guidelines for the design and construction of engineering works within the Bathurst Regional Council Local Government Area, and facilitate the expeditious processing of engineering plan submissions, construction approvals, and linen plan releases for subdivisions and developments.

Council welcomes the submission of innovative design and construction solutions which vary from the provisions contained within these guidelines, and will consider these proposals on their merits, having regard to such matters as the infrastructure design life and long-term maintenance requirements.

Developers shall be aware that all development applications are considered on the merits of the development and its overall impact on the area, and not solely in compliance with minimum engineering standards. It is imperative that all conditions of development consent imposed under the Environmental Planning and Assessment Act are addressed within the detailed engineering plans, as these conditions take precedence over the information contained herein.

When development approval includes conditions of construction which are embodied in the approved plans and specifications, the onus is on the Developer to whom the approval is given to ensure works are carried out in compliance with these conditions.

Council will hold the Developer, to whom the development approval was issued, solely responsible for constructing the approved infrastructure works and maintaining them for the duration of any maintenance period. Any Contractor carrying out subdivision or development works is directly responsible to the Developer, and not to Council.

2. DEFINITIONS

Throughout these guidelines, the following definitions and interpretations are adopted:

- ***Applicant/Developer:*** Refers to the person seeking development approval.
- ***Bathurst Regional Council (Council):*** The Local Government body that is responsible for the area known as the Bathurst Regional Council Local Government Area.
- ***Director of Engineering Services:*** The Director of Engineering Services at Bathurst Regional Council, or his nominated representative.
- ***Construction Certificate:*** Certificate provided by either Director of Environmental, Planning & Building Services or Private Certifier, which allows construction of works to proceed.
- ***Council's Engineer:*** Council officer with delegated authority from the Director of Engineering Services to carry out inspections.
- ***Cross Drainage:*** Drainage used to convey stormwater from one side of a road carriageway to the other, nominally at right angles to the road centreline.
- ***Development:*** Approved works to be carried out by the Applicant.
- ***Development Application:*** Application for approval to carry out building, engineering or other works as defined in the Local Government Act.
- ***Drawings:*** Documents presenting information in pictorial form, with or without text, including long sections, elevations, sections and other detail as necessary to fully describe the works to be carried out.
- ***Private Certifier/Engineer:*** A suitably qualified person, registered on the National

Professional Engineers Register 3, engaged by the Developer to certify that engineering works have been designed and constructed to Council's Engineering Guidelines for Development and Subdivision Works. The Director of Engineering Services may perform the role of the Private Certifier. Note that the private certifier must be independent.

- ***Registered Surveyor:*** A person registered under the *Surveyors Act, 1929*, as amended.
- ***Specifications:*** A written document with technical information, directions and conditions which deal with the quality of materials, standard of workmanship and other requirements of a development.
- ***Subdivision:*** The division, by a landowner, of all or parts of a parcel of land into separate allotments of land, each with a separate title.

3. WORK HEALTH & SAFETY

Design and construction works shall comply with the requirements of **NSW Work Health and Safety Act 2011**, **NSW Work Health and Safety Regulations 2017** and all relevant **NSW SafeWork Codes of Practice.**

4. DESIGN

See *Section 3 – General Design Standards and Requirements* for guidance on design standards and requirements.

5. SUBMISSION OF DRAWINGS AND SPECIFICATIONS

5.1 ENGINEERING DRAWINGS

The Developer is required to submit one electronic copy of plans in PDF format to Council prior to the commencement of any development or subdivision site works.

As a minimum, the engineering plans shall contain the following:

- Cover Sheet
- Notes & Details
- Road Details
- Stormwater and Subsoil Drainage Infrastructure Details
- Sewerage Infrastructure Details
- Water Infrastructure Details
- Electricity and Telecommunications Infrastructure Details
- Landscaping Details
- Soil & Water Management Details
- Traffic Management Details
- Certification Report
- Engineering Design Checklist
- Engineering Drafting Checklist
- Safety Audit

For uniformity of plan presentation and to facilitate filing and microfilming, all plan sizes, lettering, linework and symbols shall conform to the latest edition of *AS 1100 - Technical Drawing*.

Each sheet shall include bar scales showing the reduction ratio of all works shown on that sheet, with a ratio scale shown adjacent thereto. All sheets shall be signed by the Consultant/Engineer

responsible for the design of the works.

5.2 PERSONS QUALIFIED

Council requires that engineering works be designed to Council standards by a person, either holding qualifications acceptable for Corporate Membership of the Institution of Engineers, Australia, or approved by the Director of Engineering Services, and/or who has proven experience in the preparation of plans and specifications for land development.

5.3 CONSTRUCTION SPECIFICATION

These Guidelines shall in no way be interpreted as being a specification, even though design and construction criteria are included throughout. The Developer may submit their own job-specific specifications for approval where there is any variance from these standard specifications.

One electronic copy in PDF format of any job-specific specifications shall be submitted with the initial set of engineering plans, for examination by Council. One electronic copy in PDF format of the final specification shall be left with Council.

5.4 APPROVAL OF ENGINEERING DRAWINGS AND SPECIFICATIONS

Approval of drawings and specifications may be made by either a Private Certifier, or by the Director of Engineering Services, Bathurst Regional Council.

Where the Developer wishes the Director of Engineering Services to certify the development or subdivision works, the correct fee must be paid at the time of plan lodgement and submit one copy of plans and calculations in PDF format to Council for examination. Upon approval of the preliminary plans, the Developer shall make all necessary amendments and submit a final set of engineering plans. At this time the Construction Certificate will be issued.

Council's approval is conditional on the above basis and does not relieve the Developer from rectifying any errors or omissions which may become evident during construction.

Further, the approval of engineering plans and specifications is current for a period of twelve months only. Should these guidelines change before the works are substantially commenced, the Developer shall comply with the most recent version. If work has not substantially commenced inside of this twelve-month period, the Director of Engineering Services may require revised Engineering Plans and specifications to be submitted for approval.

5.5 SUBMISSION OF WORKS CONTRACTOR DETAILS

The Developer shall provide written notice of the name, address and telephone number of the works Contractor to the Director of Engineering Services at least seven days prior to the proposed date of commencement of any construction.

6. SURVEY

6.1 GENERAL

The Developer shall be responsible for the preservation of State Survey Marks in accordance with the *Surveyor General's Direction No.11 – Preservation of Survey Infrastructure.*

The Developer shall be responsible for staking out the works and ensuring compliance with the approved drawings with respect to alignment, horizontal location and level.

All plans of survey shall show connection to at least two survey control permanent marks.

Where it is intended to open a new road, at least two control marks per street of the subdivision plan shall be established in the road by the Surveyor and connected to the nearest allotment

corner.

The location and level of all permanent survey marks established as part of the works shall be clearly shown on the works as executed documentation.

Survey Control Marks and lot boundaries shall be placed in accordance with the *Surveyors (Practice) Regulation 2001,* prior to the Final Inspection of the works.

6.2 COORDINATE SYSTEM

6.2.1 General

The coordinate system for survey works shall be GDA 2020 MGA Zone 55 with Australian Height Datum (AHD) levels, unless otherwise approved.

6.2.2 Construction Survey Control Network

The Developer shall engage a registered surveyor to establish a survey control network for the site from the control marks shown in the approved drawings.

6.3 REGISTERED SURVEYOR REQUIREMENTS

Where required for the works being undertaken, the Developer shall engage a registered surveyor to execute the following types of survey works:

- To undertake site surveys as required to facilitate the preparation of accurate design documentation. Where design relates to cadastral boundaries the designer shall engage a registered surveyor to 'calculate' the lot boundaries and provide a surveyor's lot base as base file input to design. The designer shall provide the surveyor's lot base to Councils engineer as evidence that this has been properly carried out.
- Establishment of a site survey control network.
- Stakeout of works.
- Any boundary or easement works, including development of lot base for design purposes.
- Establishment and registration of permanent control marks.
- To provide works as executed (WAE) documentation to the requirements of *Clause 6.4* of this Section.

6.4 WORKS AS EXECUTED (WAE) DOCUMENTATION

6.4.1 General

The Developer shall keep a survey record as work proceeds of all works, including existing services where encountered. The Developer shall submit a WAE AutoCAD drawing, WAE plans (to be in PDF format) and WAE stormwater model information to the requirements of *Clauses 6.4.2, 6.4.3 and 6.4.4* of this Section.

Where final levels must be submitted for assessment for a works item to check construction tolerances, the WAE survey and AutoCAD drawing may be used for this purpose.

6.4.2 WAE AutoCAD Drawing

The WAE AutoCAD drawing shall include the following:

- All recorded survey points showing point number, point code, easting, northing and level for each point. Survey points that shall be included in the drawings include, but are not limited to, the following items:

- Stormwater – all above ground structures/features including pits/headwalls and invert level of all pipes at connection point with structures.
- Sewer – all above ground structures/features including manholes, inspection outlets/points, gullies, junction risers, vents, valves, pumpstations including control equipment and invert level of all pipes at connection point with structures. All junctions at connection point with the main shall be surveyed underground prior to backfill.
- Water – all above ground infrastructure including stop valve covers, hydrant valve covers, water meter covers, alignment markers, tanks and pumpstations including control equipment. Underground main details including top of pipes at intervals not exceeding 40m showing all changes in direction, grade and size and all bends, tees, junctions, hydrants, valves, thrust blocks, termination points etc. **It is a requirement that underground features be surveyed at top of pipe level prior to backfilling trenches.**
- All road infrastructure including centreline, edge of bitumen/formation/lip of kerb, invert of kerb, top of kerb, concrete paths, batters, line marking, driveways and laybacks wherever relevant. Full cross sections at all codes listed above shall be taken at intervals not exceeding 20m in any case, and showing all changes in direction, grade and widths, all high and low points and end of construction. For kerb returns, cul-de-sacs, round-a-bouts and other areas with tight radii, spacings shall not exceed 5m longitudinally in any case.
- All other infrastructure such as retaining walls, fencing, buildings/structures, earthworks structures, concrete footpaths/slabs, vegetation etc. at intervals not exceeding 20m in any case, and showing all changes in direction, grade, material and size.
- All remaining surface features shall be surveyed to show finished surface levels on a grid not exceeding 20x20m. This shall include additional points as required to accurately show all surfaces features such as top and bottom of banks, channels, swales, batters, high and low points, dams/ponding areas, changes in grade etc.
- All testing location points.

- Linework joining relevant survey points to properly show the location of all constructed/installed services, roads, buildings/structures, earthworks, surface features and any other relevant features. This shall include all existing infrastructure/services encountered during the works.
- A digital terrain model (DTM) of the completed works, for the full extent of the site including constructed batters. The supplied DTM shall be in .xml format. The digital terrain model shall only include surface level points and break lines to provide a true and accurate model of finished levels that excludes underground service levels and other levels that do not represent the true finished surface level.

Note: Point Coding and Style Requirements – points in the WAE AutoCAD drawing shall be uniquely coded, with each code having its own point style and layer, to ensure that all different services and features can be easily distinguished and allow for effective and simple display control of points within the drawing.
Note: Linework Style and Layer Control – linework in the WAE AutoCAD drawing joining relevant points shall be uniquely layered and styled, to ensure that all different services and features can be easily distinguished and allow for effective and simple display control of linework within the drawing.

6.4.3 WAE Plans (to be in PDF)

The WAE plans shall be presented in the same size as the approved drawings. Scales shall be 1:1, 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:250, 1:400 or 1:500 unless otherwise approved. The WAE plans shall include/show the following:

- Stormwater, sewer and water mains and services as-installed alignment and location. This shall include showing all pits, manholes, junctions, water valve & meter covers/lids, termination points etc.
- Stormwater – all centre of pits/headwalls/structures easting, northing and level details, all pipe incoming/outgoing invert levels at pits, pipe grades, pipe sizes and pipe materials.
- Sewer – all centre of manholes easting, northing and level details, all pipe incoming/outgoing invert levels at manholes, pipe grades, pipe sizes and pipe materials. Distances from centre of downstream manhole to each sideline, junction, dead end and the length of sidelines.
- Water – all main locations showing all stop valve, scour valve, hydrant, tee and meter locations.
- Electricity, telecommunications and gas – any variation to the standard location of allotment service connections detailed in standard drawing *EN12046 – Allotment Service Connection Details* must be shown on plans. For example – if a gas stub allotment connection is located 2m from the side boundary of the allotment rather than 1m per *EN12046*, it shall be detailed on plans for the impacted allotment.
- All other infrastructure/features including roadworks, buildings/structures, fences, footpaths, surface features etc. alignment and location. Levels also to be shown where relevant or as requested by Council's engineer.
- Pavement profile and thickness as constructed for all roads/streets. This information may be presented in table form.
- Contour depth of fill plans with depths in 250mm increments shaded or hatched.
- Removed trees allotment plan in accordance with *Clause 19.2* of this Section.
- The location and level of all installed permanent survey marks to be registered.
- Any departures from approved construction certificate plans and additional works undertaken.
- Location of public/access gates.

Each works as executed plan must include the following certification by the Registered Surveyor responsible for the preparation of the plan:

I certify that:

1. This survey is a true record of the works that have been constructed, and
2. All drainage pipes and pits are located within the drainage easements and/or reserves show on the linen plan.
3. All sewerage pipes are located within the sewerage easements and/or reserves shown on the linen plan.
4. All water pipes and fittings are located within the water easements and/or reserves shown on the linen plan.

Signature: …… Date: ……...

Name: ……

Address: ……

6.4.4 WAE Stormwater Model Information

In addition to all works as executed stormwater items detailed in Clauses *6.4.2* and *6.4.*3 of this

Section and all stormwater design information detailed in *Section 7, Clause 3* of these Guidelines, the following information shall be provided:

- Certification by suitably qualified person that original design models have not been impacted by changes to stormwater infrastructure during construction to the point where the results of the original model are no longer compliant with the requirements of these Engineering Guidelines. If certification cannot be provided, remodeling of the network, as constructed will be required and the Developer shall undertake works as required to modify the system to ensure compliance at their own expense. Certification for both the 1% (major) and 20% (minor) AEP shall be provided. All information provided at design stage in accordance with *Section 7, Clause 3* of these Guidelines shall be updated to reflect the changes.
- Where remodeling is required and undertaken, an updated copy of the 1% (major) and 20% (minor) AEP stormwater models. It is accepted that data/software file types will vary depending on the software package used by the designer. The file will become intellectual property of Bathurst Regional Council.
- The following information shall be included in the works as executed drawing:
  - Catchment areas and sub-areas, with clear labelling on connection to pits.
  - Overland flow paths.

7. WORKS CERTIFICATION

The Developer shall comply with all requirements of *Section 2 – Inspection, Testing, Submission & Material Requirements*. Certification shall be undertaken by either Council staff or a Private Certifier during construction.

The Developer shall give uninterrupted access and afford every facility for the examination of any works and materials requested by the Director of Engineering Services. The whole of the works shall be carried out to the satisfaction of the Director of Engineering Services.

If for any reason Council's engineer should relieve the Developer of the obligation to carry out construction works under the direct supervision of Council staff, then the Developer should, at the conclusion of the work, supply Council with a Compliance Certificate stating that the whole of the works have been carried out in accordance with the approved plans and specifications.

8. FEES AND CONTRIBUTIONS

Engineering drawings will be released upon payment of the appropriate plan checking and site inspection fees, current as at time of plan lodgement. Subdivisions and developments may also incur charges levied under *Section 94 of the Environmental Planning and Assessment Act*, *Section 25 of the Water Supply Authorities Act*, or as otherwise detailed in the development consent. The current value of these fees will be supplied upon request.

9. PUBLIC SAFETY

The Developer shall not obstruct and will be held responsible for the safety of the public, traffic and utility services such as electricity, water, telecommunications and the like, and shall provide temporary infrastructure, resources and controls as required to prevent accidents to public or private damage or loss.

10. PROTECTION AND SITE MAINTENANCE

The Developer shall protect the work, including existing buildings, paving, equipment and materials, to avoid damage and deterioration. The Developer shall keep the work site clean and tidy as it proceeds. The Developer is also to regularly remove from the site rubbish and surplus material arising from the execution of the work.

11. EXISTING SERVICES

11.1 GENERAL

The Developer shall engage a DBYD (Dial Before You Dig) Certified Locator to undertake all service location works. Where required for specific utility network assets, the locator shall also be registered with a Certified Locating Organisation (CLO), providing authorisation for the locator to access the utility owner's assets. The following information shall be obtained from the Developer/Certified Locator prior to the commencement of any construction works:

- A Certified Locator report in accordance with *AS 5488.1 – Classification of subsurface utility information: Subsurface utility information*. The report shall detail all utilities found on DBYD and Council asset plans along with all utilities found/located onsite and identify the quality level that all utilities have been located to. The Certified Locator shall also certify that a passive scan of the site has been undertaken to locate any unknown utilities that may be within the extent of works.
- Proof of contact, liaison and approval to proceed with works from all relevant supply authorities/asset owners, including those that may not have been identified in the DBYD enquiry.
- A pre-excavation (PEX) risk assessment for all proposed excavation works for all utilities based on the Certified Locator report and the requirements of *AS 5488.1 – Classification of subsurface utility information: Subsurface utility information*.

A copy of the above information is to be kept onsite accessible to all persons.

Where services are located onsite to quality level A or B, the Developer shall survey all location points and include these points in the Works as Executed drawings and plans as detailed in *Clause 6* of this Section.

All existing services affected by the proposed works are to be adjusted as required to the satisfaction of the relevant supply authority/asset owner. If the service shall be continued; repair, divert or relocate as required. If the service crosses the line of a required trench, or will lose support when the trench is excavated, provide permanent support for the existing service. If the service is to be abandoned; disconnect and remove service, unless otherwise approved by Council's engineer.

11.2 RESPONSIBILITY

The Developer shall bear all service relocation and diversion costs and delays. Where an existing service is damaged by the Developer for any reason whatsoever, the Developer shall bear all costs and delays for repairing the service.

12. PUBLIC UTILITY SERVICES

12.1 GENERAL

Services shall be located in accordance with Council standard drawings *EN7885* and *EN12046*.

All services shall generally run parallel to the road centreline and cross the road perpendicular to the centreline unless otherwise approved by Council's Engineer.

All Supply Authorities shall have completed the installation of services prior to the final inspection of the works by Council.

Should the installation of utility services require the opening of any public roads, reserves etc., then a road opening permit is to be obtained from Council. Restoration of disturbed areas must be completed to the satisfaction of Council's Engineer prior to the final inspection and release of linen plan.

12.2 EXISTING ROADS

Utility services to be installed across an existing roadway shall be under-bored at a depth in accordance with the relevant Supply Authorities specifications.

At no time whatsoever is an open trench to be cut, unless approved by Council's engineer.

12.3 EXISTING FOOTPATH WITH CONCRETE PAVING

The utility Supply Authority shall install the service on its correct alignment and depth. If the alignment is within a concrete footpath, the entirety of the footpath shall be removed and replaced to full width along the length of works.

The trench shall be backfilled in accordance with Council standard drawings *EN7892, EN7901 & EN7904* regardless of the service/utility type. Concrete footpath, cycleway or shared path shall be in accordance with Council standard drawing *EN7879*.

12.4 ELECTRICITY, TELECOMMUNICATIONS AND GAS

The Developer is required to supply electrical and telecommunications infrastructure, enabling all blocks to be serviced. The provision of gas infrastructure is optional. The infrastructure shall be installed in the service corridor in accordance with Council standard drawings *EN7885* and *EN12046*.

All infrastructure shall be installed in accordance with the requirements of the relevant Supply Authority, at standard locations specified by Council.

13. REPAIRS AND REMEDIATION

Where the development involves the disturbance of existing infrastructure or the Developer accidentally damages existing infrastructure, the Developer shall be responsible for repairing and remediating the disturbed or damaged infrastructure at their own cost in full accordance with any of the following standards:

- Bathurst Regional Council Guidelines for Engineering Works, including all standard drawings contained therein.
- Any relevant Australian Standard.
- National Construction Code.
- Any relevant Supply Authority standards.

In the event of any utility service being damaged or interrupted the Developer shall forthwith notify the relevant Supply Authority and take all necessary steps to provide for the safety of the public and to have the damage repaired as quickly as possible. The cost of all repairs is to be resolved between the Developer and the relevant Supply Authority.

Where private property is damaged, the Developer shall arrange with the concerned party replacement, repair, or otherwise. This cost is to be resolved between the Developer and the relevant party.

14. ADJOINING OWNERS

Where the Developer proposes to carry out work on an adjoining property, the Developer must submit the property owners written consent to Council before approval of engineering drawings will be issued. The Developer shall exercise every caution when performing work which may affect them directly or indirectly.

At the completion of engineering works, a written clearance is to be obtained from the adjoining property owner and submitted with Council prior to the Final Inspection.

15. NOISE AND VIBRATION CONTROL

The limits of *AS 2436 – Guide to noise and vibration control on construction, demolition and maintenance sites* with regards to noise and vibration levels generated by plant and equipment shall not be exceeded.

16. TRAFFIC MANAGEMENT

16.1 SCOPE

When works involve executing works on or near a road, the Developer is responsible for traffic management in accordance with the *Work Health and Safety Act 2011* and *Transport for NSW – Traffic Control at Work Sites (TCAWS Manual)*.

Aspects the Developer must manage with regards to traffic management include, but are not limited to:

- Preparation and implementation of a traffic management plan by suitably qualified persons.
- Preparation and implementation of traffic guidance schemes for specific works throughout the Contract by suitably qualified persons.
- Adaption of the traffic management plan and traffic guidance schemes throughout works as required for changing work sites and conditions.
- Continuous monitoring and maintenance of all traffic devices, including daily record keeping for proof of compliance.
- Liaison with affected community stakeholders in the vicinity when developing traffic management and traffic guidance schemes.

16.2 TRAFFIC CONTROL STANDARDS

In addition to requirements of the *Work Health and Safety Act 2011*, the following standards shall also be complied with:

- *AS 1742 – Manual of uniform traffic control devices*
- *AS 4852 – Variable message signs*
- *Transport for NSW – Traffic Control at Work Sites (TCAWS Manual)*

17. COMPLETION OF WORKS

When the Developer is of the opinion that all works have been satisfactorily completed, the Developer shall arrange with Council's Engineer for a Final Inspection to be performed.

The Developer and/or Contractor shall be present for the Final Inspection and shall assist Council's Engineer in checking of levels, opening of manholes etc. as required.

All street name signs, advisory/warning signs, and traffic control devices shall be installed prior to Council's Final Inspection.

If all engineering works are satisfactory, Council will issue a Notification of Completion. Council's Engineer may allow minor errors, omissions, or defects to be bonded or completed during the maintenance period; however, any major defects or omissions must be repaired before a Notification of Completion will be issued.

18. BONDS AND GUARANTEES FOR PERFORMANCE

Where Council holds a bond or bank guarantee and works have not been satisfactorily completed within the agreed time frame, the Director of Engineering Services may either grant

an extension of time or complete the works at the Developer's expense. If serious defects arise which require urgent attention due to safety concerns or otherwise, Council may rectify works and shall either use the bond money as payment or bill the Developer.

18.1 MAINTENANCE BOND

Where a Developer constructs or provides public infrastructure, a maintenance bond equal to 5% of the total development cost shall be lodged with Council prior to acceptance of the facility. A minimum bond amount of $1500 shall apply.

The maintenance bond is held by Council to ensure that all public infrastructure works have been constructed to a satisfactory standard and can withstand the rigours of service conditions. Unexpended bond monies are refunded to the Developer at the expiry of the maintenance period.

18.2 MAINTENANCE DEFECT PERIOD

The duration of the maintenance period shall be a **minimum** of 12 months from the date of lodgement of the bond, or from the date of a satisfactory Final Inspection of the works, whichever is the later. However, if in the opinion of the Director of Engineering Services, the infrastructure has not been subjected to normal operating conditions during this time, the maintenance period may be extended until such time as the facility has been adequately tested.

Within the maintenance period, the Developer is expected to rectify any defect or omission which becomes apparent in the Development. Council may seize bond money to rectify faults if they have not been repaired within a reasonable time, or if necessary, to urgently repair a defect which could conceivably cause harm or injury to persons or property.

18.3 BOND FOR EARLY RELEASE OF LINEN PLAN

Where engineering works for a subdivision or development are nearly complete, the Director of Environmental, Planning & Building Services may accept a bond from the Developer for completion of works within a specified time after release of the linen plan. A non-refundable fee applies for preparation of the early release by the Director of Engineering Services, and the amount of the bond or bank guarantee shall be double the estimated cost of the works.

Early release shall not be permitted in cases where the construction of water, sewer and stormwater infrastructure is not complete, nor if individual blocks are not accessible by an all-weather road.

19. TREE REMOVAL

19.1 TREE PRESERVATION

Council has placed a Tree Preservation Order on all trees situated in the city with a height more than 4 metres and branch spread more than 3 metres diameter.

This order prohibits, without the prior approval of Council, the ring barking, cutting down, topping, lopping, removal or wilful destruction of trees, notwithstanding whether such trees are on public or private land.

Developers wishing to carry out work on trees shall submit a Tree Preservation Form, signed by the owner of the land, to Council's Recreation Section.

Trees within lands formerly administered by Evans Shire Council are not subject to the Tree Preservation Order.

19.2 REMOVED TREES ALLOTMENT MAPPING

Where trees are removed as part of a Development, the Developer shall accurately map the

exact location of all trees removed and overlay with the allotment layout (both existing and proposed allotments). This information shall be provided to Council in drawing format and shall meet all survey requirements of *Clause 6* of this Section.

This will allow Council to notify future owners of the land of the likely presence of organic matter below the surface within the allotment.

20. CARE OF VEGETATION TO BE RETAINED

20.1 GENERAL

No trees and/or shrubs (vegetation) shall be destroyed or damaged by the Developer other than those specified in the approved development documentation.

Vegetation to be preserved shall always be adequately protected and particular care shall be taken to avoid any damage to the roots, trunks and branches. If necessary, for this purpose, equipment shall be kept clear of the drip zone of vegetation and hydro-excavation shall be adopted to avoid damage.

20.2 CLEARANCES

Parrawebbing or other approved suitable fencing shall be placed around the drip zone of all vegetation to prevent unnecessary access and subsequent damage to the drip zone area.

20.3 VEGETATION IN FILL

Trees in more than 300mm of fill shall be provided with a retaining wall. In such cases, an independent arborist shall provide advice regarding appropriate treatment.

20.4 ROOTS

Roots shall not be ripped out. When any excavation is required in the vicinity of trees to be retained, hydro-excavation shall be made to first locate any roots. Roots that are then seen to be affected by the line of the proposed work shall be cleanly severed clear of the work before machine excavation commences.

20.5 BRANCHES

Where branches of trees marked to be preserved protrude into the working area so that these cannot be avoided, arrangement shall be made, on approval by Council, for their removal by the Developer.

If, in the opinion of Council, any tree or shrub to be preserved contains branches which are dangerous, such branches shall be removed and disposed of.

21. COMPLIANCE WITH ACTS

It is the responsibility of the Developer and Contractor/s to ensure that all works are undertaken in a safe manner. In particular, the Developer and all Contractor/s shall ensure compliance with the Work Health and Safety Act and any other relevant Acts, Ordinances, and Regulations.

22. STREET LIGHTING

In accordance with the Development Control Plan, the Developer is required to provide appropriate street lighting for the whole of the Development and shall comply with:

- *AS 1158 – Lighting for roads and public spaces*
- *AS 60598 - Luminaires*
- *Relevant Supply Authority standards and requirements*

23. DISPOSAL OF CONTAMINANTS AND REFUSE

Runoff water carrying cement or silt shall be prevented from entering pipelines both on and off site. Contaminates shall be removed from the site and refuse disposed of in a lawful manner. This shall include compliance with all requirements and procedures described in the most recent version of the *Transport for NSW Technical Direction (Environmental) – Legal offsite disposal of waste* document.

Proof of legal disposal all contaminants and contaminated materials shall be filed and provided to Councils engineer, including all documentation records required by the *Transport for NSW* document specified above.

24. FENCING AND EXISTING FENCES

Secure site fencing shall be provided in accordance with the *Work Health and Safety Act 2011*. Where necessary, to prevent trespass or the straying of stock, the Developer shall erect additional temporary fences and gates, all of which shall be equivalent to and as effective as the existing fences and gates. During the progress of works, gates shall be kept securely locked when not in use.

25. HANDRAIL AND BALUSTRADE TO DROP OFFS

Where completed structures in areas accessible to the general public have an effective fall height exceeding 900mm, the Developer shall supply and install handrail/balustrade in accordance with the requirements of the following standards as applicable:

- *AS 1170 – Structural design actions*
- *AS 1428 – Design for access and mobility*
- *AS 1657 – Fixed platforms, walkways, stairways and ladders*
- *AS 2156 – Walking tracks*
- *National Construction Code*

26. ZONE OF INFLUENCE COMPLIANCE FOR COUNCIL SERVICES

No building/structural loads shall be imposed on any Council stormwater, water or sewerage service or main. As part of engineering plans required prior to issue of a Construction Certificate, the Developer shall submit a zone of influence design and construction plan detailing the following information as a minimum:

- The invert RL of all services on each side of the extent of the proposed building/structure/development. The service shall be physically located (exposed with non-damaging excavation where required) prior to the levels being taken. For stormwater and sewer, the invert levels may be taken from the upstream/ downstream manholes/pits to prevent the need for physical location using excavation where suitable. Levels from works as executed plans will not be accepted as a substitute to physical locating.
- The grade of all located services based on physical location RL's.
- A site benchmark RL, either installed or on an existing hard standing surface that will not be disturbed during works, at a location that will have line of sight to all building/structure footings and piers requiring zone of influence inspection.
- The depth from finished surface level *and* invert/bottom RL required for all footings/piers to ensure that Council services are not within the zone of influence of the structure. Proof of calculations by the engineer to determine the required depth based on the zone of influence diagram as per Council Standard Drawing *EN7902* shall also be provided.
- The plan shall be signed and certified by a suitably qualified engineer confirming that all

services will be outside the zone of influence based on the depth and RL's detailed for the footings/piers of all structures.

All footings and piers shall be inspected by Council staff to confirm that the design invert RL's have been achieved in accordance with the approved zone of influence design and construction plan.

For additional specific zone of influence requirements and conditions for each type of Council service, refer to *Section 7 – Stormwater and Subsoil Drainage, Section 8 – Water Infrastructure* and *Section 9 – Sewerage Infrastructure*.

27. SERVICE MAINS UNDERGROUND WARNING TAPE

All underground service mains shall be installed with detectable underground warning tape in accordance with *AS 2648 – Underground marking tape*. Tape shall be a minimum 100mm wide. Tape shall be installed 200-300mm above the centreline of the pipe/conduit as appropriate based on the bedding/backfill surround required for the pipe/conduit type.

The following colours/wording shall be used for each service type:

- Stormwater - tape shall be dark blue in colour with wording "Stormwater Main Below" or approved equivalent.
- Sewer - tape shall be cream or beige in colour with wording "Sewer Main Below" or approved equivalent.
- Water – tape shall be green in colour with wording "Water Main Below" or approved equivalent. Distinguishment of water main types with different colours or wording is not required – e.g. raw water and fire line mains do not need to be installed with purple or red tape with specific wording.
- Electrical - tape shall be orange in colour with wording "Electrical Main Below" or approved equivalent.
- Telecommunications - tape shall be white in colour with wording "Telecommunication Main Below" or approved equivalent.
- Gas - tape shall be yellow in colour with wording "Gas Main Below" or approved equivalent.

Where existing/installed service warning tape is damaged, it shall be reinstated at the same level as the existing tape, overlapping with the undamaged existing tape for a minimum of 1m.

28. SOIL & WATER MANAGEMENT

28.1 GENERAL

The Developer shall develop an Erosion and Sediment Control Plan (ESCP) or Soil and Water Management Plan (SWMP) in accordance with the *NSW Blue Book*. The *NSW Blue Book* recommends that an ESCP be required where the area of land to be developed is between 250m2 and 2500m2, and a SWMP where the disturbance is greater than 2500m2 or for developments in or near critical habitats.

The matters to be considered in the preparation of ESCP or SWMP are detailed in the *NSW Blue* Book. These include, but are not limited to:

- Slope and soil characteristics.
- Conserve topsoil and consider ecologically sustainable principles and measures.
- Location and details of proposed control measures.
- Control of stockpiles and re-use of material on site.

- All weather access to the site.
- Location of existing vegetation and vegetation to be removed.
- Proposed method of protection of vegetation.
- Water bodies, dams and other drainage structures.
- Soil and water implications.
- Design storms for rainfall and design storms for basin stability.
- Re-stabilisation/revegetation details.
- Construction site location/disturbed area boundaries.
- Clean-up of downstream sedimentation resulting from breach of erosion and sedimentation controls.
- Order of works based upon construction and stabilisation of all culverts and surface drainage works at the earliest practical stage.
- Proposed time schedules for construction of structures and implementation of control measures and details of proposed maintenance, inspection, and corrective action.

The matters listed above shall be addressed by the inclusion of the following in the ESCP or SWMP:

- A set of plans drawn to scale which show the layout of appropriate sedimentation and erosion control works which meet the objectives of the *NSW Blue Book*.
- A commentary that outlines appropriate sedimentation and erosion control features to achieve the necessary objectives of the *NSW Blue Book*.

Where practical, all runoff from areas upslope shall be diverted away from any disturbed or stockpile areas. Diverted stormwater shall be discharged onto stable areas and shall not be diverted into neighbouring properties unless written permission is obtained from the landowner/s and Council. Avoid directing stormwater towards the site's access and egress.

All contaminated runoff shall be treated on site in accordance with the ESCP or SWMP.

In addition to the legislation, all works onsite shall be carried out in accordance with development approvals.

All disturbed areas shall be re-stabilised/re-vegetated prior to the removal of control features.

The cost of design, implementation, and adaption of soil and water management measures shall be borne by the Developer.

28.2 CERTIFIED PROFESSIONAL IN EROSION & SEDIMENT CONTROL (CPESC) REQUIREMENTS

Where development approvals require that a Certified Professional in Erosion & Sediment Control (CPESC) qualified person must be used throughout the duration of the development to ensure compliance with the *NSW Blue Book*, the Developer shall bear all expenses.

28.3 SOIL & WATER CONTROL DEVICES

The Developer shall ensure that control devices are placed in the locations shown on the approved ESCP or SWMP, unless an alternative location is directed by a CPESC or Council. Control devices shall be constructed of material and installed in accordance with the *NSW Blue Book*.

28.4 SOIL & WATER CONTROL MAINTENANCE

All control devices shall be maintained in a satisfactory working order throughout the works and Defects Liability Period, or until such earlier time as the area above has been stabilised and rehabilitated and Council directs that the devices be removed.

The Developer shall inspect the devices after each storm for structural damage or clogging by silt and other debris and make prompt repairs, replacement or adjustments.

All sediment deposited within ponded areas shall be periodically removed to a disposal area identified in the approved ESCP or SWMP.

Filter type control shall be cleaned and restacked or replaced or required, when directed to maintain effective performance.

In the case of the stabilised site access, the Developer shall undertake weekly surface cleaning to remove all build-up of foreign material.

To control bank growth and to maintain healthy ground cover in channels and on banks, mowing shall be undertaken as required or as directed.

28.5 STABILISATION OF DISTURBED AREAS

The Developer shall ensure that disturbed areas are stabilised as detailed in the ESCP or SWMP and in accordance with the *NSW Blue Book*.

Topsoiling, seeding, turfing, hydroseeding and hydromulching works shall comply with the requirements of *Section 4 – Site Restoration & Landscaping*.

Slopes exceeding 1:6 shall be stabilised with topsoil and hydroseed or hydromulch as a minimum. Where approved for use, slopes exceeding 1:4 shall be stabilised with topsoil, hydroseed or hydromulch and jute mesh installed to manufacturers specifications as a minimum.

SECTION 2 – INSPECTION, TESTING, SUBMISSION & MATERIAL REQUIREMENTS

1. SCOPE

This Section of the Guidelines for Engineering Works outlines Council's inspection, testing and submission requirements including documentation procedures.

2. DOCUMENTATION REQUIREMENTS

A range of documents shall be obtained, recorded, filed, and submitted to Council's engineer both prior to, during and after the completion of specific work items through to a subdivision certificate being awarded.

If the Developer fails to obtain and document approvals, the works will be assumed to be non-compliant unless prior written approval has been obtained from Council's engineer.

3. ITEMS REQUIRING APPROVAL

The Developer will be required to obtain approval for items detailed in Tables 2.1, 2.2, 2.3, 2.4 and 2.5 of this Section. Obtaining approval for different items will require a combination of methodology plans, design documents, material and item specification documents, onsite inspections, onsite testing, batch testing, in-situ testing, during works construction survey and works as executed survey.

Table 2.3 details suitably qualified persons/companies authorised to undertake inspections and tests. This includes suitable replacements for a Council engineer/officer in cases where the Developer chooses to have works items certified privately. The Developer shall arrange the suitably qualified persons/companies to undertake the inspection and testing works as required. Suitably qualified persons/companies that may be required to undertaken supervision, inspections or tests on any given item include:

- Level 1 Geotechnical Inspection and Testing Authority (GITA).
- Level 2 Geotechnical Testing Authority (GTA).
- NATA accredited laboratory.
- A civil engineer on the National Engineering Register (NER).
- Diploma level Horticulturist.
- Council engineer/officer.

Council reserves the right to add additional requirements to those conditioned at any stage of the Development.

3.1 CONSTRUCTION INSPECTIONS, TESTING AND SUBMISSIONS

The Developer shall obtain approval for all items nominated by Council's engineer from Tables 2.1, 2.2, 2.3 and 2.4. The requirements for any given development will vary and are at the discretion of Council's engineer.

3.2 CONSTRUCTION MATERIALS

The Developer shall obtain approval for all items nominated by Council's engineer from Table 2.5. The requirements for any given development will vary and are at the discretion of Council's engineer.

4. FILING AND SUBMISSION REQUIREMENTS

The Developer shall submit all files/documentation required to obtain approval to a location advised by Council's engineer.

4.1 MATERIAL SPECIFICATION SUBMISSION REQUIREMENTS

Material specification submissions shall provide proof of compliance with all standards and specifications relevant to the specific material. For example – submitted manufacturer specifications for precast stormwater concrete pipes must show that the pipes are manufactured in accordance with *AS 4058 – Precast concrete pipes*.

4.2 TESTING CERTIFICATE REQUIREMENTS

All test certificates from NATA laboratories or other approved testing companies shall show the following information as a minimum:

- Company and person executing the testing.
- Easting, northing and level of test location (in approved coordinate system) where relevant.
- Date and time of sample collection where relevant.
- Date of testing.
- Full test description.
- Results including comparison with approved parameters and statement of pass/failure.

5. LIST OF INSPECTION, TESTING AND SUBMISSION REQUIREMENTS

The Developer shall arrange all required inspections, tests and submissions as detailed by Council's engineer. Tables 2.1, 2.2, 2.3 and 2.4 form the basis of standard requirements that may be required by Council's engineer, but additional Development specific requirements may be added at Council's discretion. Each table details the requirements at different stages throughout the development, as detailed below:

- Table 2.1 – Requirements at consent stage.
- Table 2.2 – Requirements at subdivision works certificate stage.
- Table 2.3 – Requirements at construction stage.
- Table 2.4 – Requirements at subdivision certificate stage.

The Developer shall submit an Inspection and Testing Plan (ITP) for approval prior to issue of a subdivision works certificate. The specific requirements of the ITP shall be detailed at consent stage and will be a combination of the following requirements:

- Details on how compliance for earthworks to Level 1 GITA requirements will be achieved.
- Details on suitably qualified persons who will undertake Level 2 GTA, NATA laboratory, NER civil engineer and diploma level horticulturist inspections and tests.
- Details on how compliance will be obtained for material specification and testing requirements.
- Frequencies of all inspections and tests (shall be in accordance with the relevant Section of these Guidelines).
- Reporting and documentation format.

In addition to testing requirements detailed in Tables 2.1, 2.2, 2.3 and 2.4, the Developer will be required to provide survey information detailed in *Section 1 – General, Clause 6.*

TABLE 2.1 – List of Submissions Required at Consent Stage

To be specified by Council at Pre-DA Stage or Consent Stage.

Item Description
Section 2 – Inspection, Testing, Submission & Material Requirements
Submissions
Bulk earthworks plan
Slope management plan
Section 3 – General Design Standards & Requirements
Submissions
Proof of landowners consent

TABLE 2.2 – List of Submissions Required at Subdivision Works Certificate Stage

To be specified by Council at Consent Stage or Subdivision Works Certificate Stage.

Item Description
Section 2 – Inspection, Testing, Submission & Material Requirements
Submissions
Survey control and quality assurance plan
Inspection and testing plan
Section 3 – General Design Standards & Requirements
Submissions
Full set of design plans suitable for use as construction drawings
Detailed digital terrain model to be provided with design plans
Proof that registered surveyor has been engaged to calculate the lot boundaries and provide the surveyors lot base for design
Proof that NATA registered geotechnical company has been engaged as required to provide accurate design information
Proof that infrastructure has been designed for appropriate design life
Engineering design checklist
Engineering drafting checklist
Section 5 – Earthworks
Submissions
Filling, embankments and backfill compaction methodology plan
Section 6 – Roads
Submissions
Bituminous pavement construction quality control and methodology plan
Roundabout landscaping, vegetation, irrigation and sight distance plans showing compliance with *Austroads* and *EN10775*
Section 7 - Stormwater & Subsoil Drainage
Submissions
Zone of influence design and construction plan
Section 8 – Water Infrastructure
Submissions
Zone of influence design and construction plan
Section 9 – Sewerage Infrastructure

Item Description
Submissions
Zone of influence design and construction plan
Section 10 – Concrete
Submissions
Concrete finishing, curing and protection methodology plan
Section 12 – Water Sensitive Urban Design
Submissions
Water quality including MUSIC modelling design report
Gross pollutant traps design report

TABLE 2.3 – List of Inspections, Tests & Submissions Required at Construction Stage

To be specified by Council at Subdivision Works Certificate Stage or Construction Stage.

Item Description
Section 4 - Site Restoration & Landscaping
Inspections
Trees/plants in pots prior to planting by diploma level horticulturist or Council
Garden soil for tree planting by diploma level horticulturist or Council
Regular tree planting hole, root barrier & subsoil pipe prior to backfill by diploma level horticulturist or Council
Passively irrigated tree bore hole prior to backfill by diploma level horticulturist or Council
Passively irrigated tree bore hole after backfill by diploma level horticulturist or Council
Passively irrigated tree soil cells & root barrier prior to backfill by diploma level horticulturist or Council
Passively irrigated tree after backfill & prior to planting by diploma level horticulturist or Council
Passively irrigated tree bedding sand prior to porous paver placement by diploma level horticulturist or Council
Roundabout garden soil prior to mulch placement & vegetation plantings by diploma level horticulturist or Council
Testing & Survey
Onsite stockpiled topsoil testing by NATA laboratory
Imported topsoil testing by NATA laboratory
Bore hole backfill material testing by NATA laboratory
Survey in accordance with *Section 4, Clauses 10.2 & 10.3*
Submissions
Material submissions in accordance with Table 2.5
Section 5 – Earthworks
Inspections
Subgrade inspection and deflection testing proof roll prior to placement of any other material including fill, embankments, pavements, footpaths, kerbs and structures by Level 1 GITA, Level 2 GTA or NATA laboratory
Finished cut, fill and embankment works inspection and proof roll prior to placement of topsoil or any other materials by Level 1 GITA, Level 2 GTA or NATA laboratory
Testing & Survey
Fill and embankment material testing prior to placement by Level 2 GTA or NATA laboratory (not required when works under Level 1 GITA supervision)

Item Description
Foundations and subgrades standard maximum dry density (SMDD) and california bearing ratio (CBR) testing by Level 2 GTA or NATA laboratory (not required when works under Level 1 GITA supervision)
Filling and embankments SMDD and CBR testing for each compacted layer by Level 2 GTA or NATA laboratory (not required when works under Level 1 GITA supervision)
Imported and exported material waste classification testing in accordance with *EPA Waste Classification Guidelines*
Survey in accordance with *Section 5, Clauses 13.2 & 13.3*
Section 6 - Roads
Inspections
Subgrade inspection and deflection testing proof roll by Level 1 GITA, Level 2 GTA, NATA laboratory, NER civil engineer or Council
Flexible pavement subbase inspection and deflection testing proof roll by NER civil engineer or Council
Flexible pavement base inspection and deflection testing proof roll by NER civil engineer or Council
After milling of existing pavement prior to any further works by NER civil engineer or Council
Sprayed bituminous prime coat prior to placement of any asphalt by NER civil engineer or Council
Each asphalt course inspection by NER civil engineer or Council
Asphalt wearing course inspection by NER civil engineer or Council
Sprayed bituminous surfaces inspection by NER civil engineer or Council
Testing & Survey
Flexible pavement nominated material tests to show full compliance with *TFNSW 3051* by NATA laboratory
All subgrade/flexible pavement courses SMDD and CBR testing by NATA laboratory
Asphalt nominated mix testing to show full compliance with the relevant *TFNSW QA Roadworks Specification* by NATA laboratory
Asphalt production mix particle size distribution and binder contest testing by NATA laboratory
Asphalt base and wearing courses insitu air voids testing by NATA laboratory
Sprayed bituminous surfacing production mix certified records stating compliance with the relevant *TFNSW QA Roadworks Specification*
Sprayed bituminous surfacing certified binder spray rates records
Sprayed bituminous surfacing certified aggregate application rate records
Survey in accordance with *Section 6, Clauses 11.2 & 11.3*
Submissions
Material submissions in accordance with Table 2.5
Section 7 - Stormwater & Subsoil Drainage
Inspections
Stormwater trench and pipe bedding prior to backfill, including trench stops by NER civil engineer or Council
Stormwater pipe backfill prior to covering by NER civil engineer or Council
Stormwater pit bedding prior to backfill by NER civil engineer or Council
Stormwater pit backfill prior to covering by NER civil engineer or Council
Stormwater pits after rendering openings and prior to backfill by NER civil engineer or Council
Subsoil trench, pipe and bedding prior to backfill, including trench lining material where required by NER civil engineer or Council
Subsoil pipe backfill prior to covering, including trench lining material where required by NER civil engineer or Council

Item Description
Anchoring/thrust blocks and concrete bulkheads formwork prior to pouring by NER civil engineer or Council
Anchoring/thrust blocks and concrete bulkhead cured concrete prior to backfill by NER civil engineer or Council
Zone of influence inspections where structures adjacent to stormwater infrastructure by NER civil engineer or Council
Testing & Survey
Trench backfill supervision by Level 1 GITA or SMDD testing by Level 2 GTA or NATA laboratory
CCTV inspection of all installed pipes
Stormwater pipe bedding/backfill material and subsoil drainage filter material testing by NATA laboratory
Survey in accordance with *Section 7, Clauses 11.2, 11.3 & 11.4*
Submissions
Material submissions in accordance with Table 2.5
Section 8 – Water Infrastructure
Inspections
Water trench and pipe bedding prior to backfill, including trench stops by NER civil engineer or Council
Water pipe backfill prior to covering by NER civil engineer or Council
Anchoring/thrust blocks and concrete bulkheads formwork prior to pouring by NER civil engineer or Council
Anchoring/thrust blocks and concrete bulkhead cured concrete prior to backfill by NER civil engineer or Council
Installed markers/covers by NER civil engineer or Council
Zone of influence inspections where structures adjacent to water infrastructure by NER civil engineer or Council
Testing & Survey
Trench backfill supervision by Level 1 GITA or SMDD testing by Level 2 GTA or NATA laboratory
Water pipe bedding/backfill material testing by NATA laboratory
Pressure testing by NATA laboratory (Council representative to be present during testing)
Disinfection testing by NATA laboratory (Council representative to be present during testing)
Survey in accordance with *Section 8, Clauses 6.2 & 6.3*
Submissions
Material submissions in accordance with Table 2.5
Section 9 – Sewerage Infrastructure
Inspections
Sewerage trench and pipe bedding prior to backfill, including trench stops by NER civil engineer or Council
Sewerage pipe backfill prior to covering by NER civil engineer or Council
Sewerage manhole bedding prior to backfill by NER civil engineer or Council
Sewerage manhole pit backfill prior to covering by NER civil engineer or Council
Anchoring/thrust blocks and concrete bulkheads formwork prior to pouring by NER civil engineer or Council
Anchoring/thrust blocks and concrete bulkhead cured concrete prior to backfill by NER civil engineer or Council
Zone of influence inspections where structures adjacent to sewerage infrastructure by NER civil engineer or Council
Testing & Survey

Item Description
Trench backfill supervision by Level 1 GITA or SMDD testing by Level 2 GTA or NATA laboratory
CCTV inspection of all installed pipes
Sewerage pipe bedding/backfill material testing by NATA laboratory
Air pressure testing of pipes by NATA laboratory
Water testing of manholes by NATA laboratory
Survey in accordance with *Section 9, Clauses 6.2 & 6.3*, including all sewer junctions
Submissions
Material submissions in accordance with Table 2.5
Section 10 – Concrete
Inspections
Subgrade inspection and proof roll prior to placement of bedding material by NER civil engineer or Council
Bedding material and formwork/reinforcing steel prior to placement of concrete by NER civil engineer or Council
Testing & Survey
Nominated mix compressive strength (F28) after 28 days by NATA laboratory – required for kerbs, drains, median islands, footpaths, cycleways, driveways/accesses, laybacks and perambulator crossings
Production mix compressive strength (F28) after 28 days taken onsite during delivery by NATA laboratory – required for kerbs, drains, median islands, footpaths, cycleways, driveways/accesses, laybacks and perambulator crossings
Survey in accordance with *Section 10, Clauses 4.2 & 4.3*
Submissions
Material submissions in accordance with Table 2.5
Section 11 – Open Space Areas
Inspections
All inspections listed in *Section 4 – Site Restoration & Landscaping*
Furnishings installation completion by Council
Testing
All tests listed in *Section 4 – Site Restoration & Landscaping*
Submissions
All submissions listed in *Section 4 – Site Restoration & Landscaping*
Section 12 – Water Sensitive Urban Design
Submissions
Material submissions in accordance with Table 2.5

TABLE 2.4 – List of Inspections & Submissions Required at Subdivision Certificate Stage

To be specified by Council at Subdivision Works Certificate Stage or Construction Stage.

Item Description
Section 2 – Inspection, Testing, Submission & Material Requirements
Submissions
Removed trees allotment mapping
Section 3 – General Design Standards & Requirements
Submissions
Proof that easements have been created by a registered surveyor based on works as executed survey
Proof of all relevant Supply Authorities certification
Works as executed documentation in accordance with *Section 1, Clause 6* (required for all Developments)
Section 4 - Site Restoration & Landscaping
Inspections
Site restoration completion by Council
Landscaping completion by Council
Section 5 - Earthworks
Submissions
All Level 1 GITA, Level 2 GTA and NATA reports as relevant
Section 6 - Roads
Submissions
All NATA reports as relevant
Section 7 - Stormwater & Subsoil Drainage
Submissions
All Level 1 GITA, Level 2 GTA and NATA reports as relevant
CCTV footage and reporting
Zone of influence certification
Section 8 – Water Infrastructure
Submissions
All Level 1 GITA, Level 2 GTA and NATA reports as relevant
Zone of influence certification
Section 9 – Sewerage Infrastructure
Submissions
All Level 1 GITA, Level 2 GTA and NATA reports as relevant
CCTV footage and reporting
Zone of influence certification
Section 10 – Concrete
Submissions
Production mix compressive strength reporting
All NATA reports as relevant
Section 11 – Open Space Areas
Inspections
All inspections listed in *Section 4 – Site Restoration & Landscaping*
Furnishings installation completion by Council

6. LIST OF MATERIAL REQUIREMENTS

The Developer shall arrange for provision of all material specifications and testing required by Council's engineer. Table 2.5 below forms the basis of standard requirements that may be required by Council's engineer, but additional Development specific requirements may be added at Council's discretion.

No works using materials on this list shall be commenced prior to obtaining approval for use. Any changes to approved materials throughout the Development will require reapproval by Council's engineer.

NATA testing will be required in addition to specification details for quarried, earthern/soil and batched materials/products. See relevant Section of Guidelines for further details on material specification requirements.

TABLE 2.5 – List of Material Specification & Testing Requirements

To be specified by Council at Subdivision Works Certificate Stage or Construction Stage.

Material
Section 4 - Site Restoration & Landscaping
Onsite stockpiled topsoil
Imported topsoil
Seed mix
Hydromulch/hydroseed mix
Fertiliser
Turf
Plant species
Geofabric
Jute Mesh
Trees
Tree & Roundabout Garden Soil
Tree Structural Cell
Tree Bedding Sand
Tree Root Barrier
Tree Porous Pavers
Section 5 - Earthworks
Onsite bulk earthworks material
Imported bulk earthworks material
Section 6 - Roads
Flexible base course materials
Flexible sub-base course materials
Sprayed bituminous surfacing nominated and production mixes
Asphalt nominated and production mixes
Line marking paint
Signage
Speed bumps
Guardrail
Raised pavement markers

Material
Temporary road barriers
Bollards
Wheel stops
Guide posts
Separation kerb
Rumble strips
Rumble bars
Section 7 - Stormwater & Subsoil Drainage
Stormwater pipes
Stormwater box culverts
Subsoil pipes
Stormwater pits
Stormwater pit covers & grates
Step irons
Flood gates
Headwall inlet grates
Warning tape
Bedding/backfill material
Section 8 – Water Infrastructure
Water main pipes
Water service pipes
Water fittings/bends/joints
Hydrants
Valves
Covers
Meters
Backflow prevention devices
Polyethylene sleeving & PVC tape
Markers and posts
Warning tape
Bedding/backfill material
Section 9 – Sewerage Infrastructure
Manholes and risers
Sewer pipes
Sewer fittings/joints
Covers
Polyethylene sleeving & PVC tape
Warning tape
Bedding/backfill material
Section 10 – Concrete
Concrete path nominated & production mixes
Kerb nominated & production mixes
Driveway nominated & production mixes
Other/Miscellaneous
Masonry blocks

Material
Masonry bricks
Retaining wall materials
Utilities services trenching bedding/backfill material
Light poles
Light luminaires
Fencing components including gates & locks
Handrail/balustrade
Open space barrier
Open space gate
Gross pollutant traps

7. APPROVAL/INSPECTION CERTIFICATE TEMPLATE

APPROVAL/INSPECTION CERTIFICATE	
ITEM BEING ASSESED FOR APPROVAL:	
DATE:	
DEVELOPER'S REPRESENTATIVE:	
CERTIFIER NAME & COMPANY:	
ATTACHMENTS RELEVANT TO ITEM APPROVAL	
CERTIFIER COMMENTS	
ITEM APPROVED (Y/N)	
DEVELOPERS'S REPRESENTATIVE SIGNATURE:	……
CERTIFIER SIGNATURE:	……..

SECTION 3 – GENERAL DESIGN STANDARDS & REQUIREMENTS

1. SCOPE

This Section of the Guidelines for Engineering Works outlines Council's design standards and requirements.

2. STANDARDS

Unless otherwise specified or approved, design shall be in accordance with the latest relevant Australian Standard or standards relevant to the type of design being undertaken.

Standards include, but are not limited to:

Design and Drawings Generally:

- *AS 1100 – Technical drawing*
- *National Construction Code*
- *Work Health and Safety Act 2011*

Structural Design:

- *AS 1170 – Structural design actions*
- *AS 1288 – Glass in buildings*
- *AS 1657 – Fixed platforms, walkways, stairways and ladders – Design, construction and installation*
- *AS 1684 – Residential timber-framed construction*
- *AS 1720 – Timber structures*
- *AS 1726 – Geotechnical site investigations*
- *AS 2327 – Composite structures*
- *AS 2870 – Residential slabs and footings*
- *AS 3600 – Concrete structures*
- *AS 3610 – Formwork for concrete*
- *AS 3700 – Masonry structures*
- *AS 4100 – Steel structures*
- *AS 4600 – Cold-formed steel structures*
- *AS 4673 – Cold-formed stainless steel structures*
- *AS 4678 – Earth-retaining structures*
- *AS 5100 – Bridge design*

Road/Pavement Design:

- *AS 2150 – Hot mix asphalt – A guide to good practice*
- *AS 2890 – Parking facilities*
- *AS 3845 – Road safety barrier systems and devices*
- *Austroads Guide to Road Design – Part 1 to Part 8*
- *Transport for NSW Supplement to Austroads Guide to Road Design – Part 1 to Part 8*
- *Austroads Guide to Pavement Technology – Part 2: Pavement Structural Design*

- *Transport for NSW Supplement to Austroads Guide to Pavement Technology – Part 2: Pavement Structural Design*

Hydrologic/Hydraulic Design:

- *AS 3500 – Plumbing and Drainage*
- *Australian Rainfall and Runoff: A Guide to Flood Estimation*

Water Design:

- *AS 3500 – Plumbing and Drainage*
- *Water Services Association of Australia – Water Supply Code of Australia*

Sewer Design:

- *AS 3500 – Plumbing and Drainage*
- *Water Services Association of Australia – Pressure Sewerage Code of Australia*
- *Water Services Association of Australia – Vacuum Sewerage Code of Australia*
- *Water Services Association of Australia – Gravity Sewerage Code of Australia*
- *Water Services Association of Australia – Sewage Pumping Station Code of Australia*

Electrical and Lighting Design:

- *AS 1158 – Lighting for roads and public spaces*
- *AS 3000 – Electrical installations*
- *AS 4676 – Structural design requirements for utility service poles*
- *All relevant Supply Authority standards and requirements*

Telecommunications Design:

- *All relevant Supply Authority standards and requirements*

Access, Fencing and Handrail Design:

- *AS 1428 – Design for access and mobility*
- *AS 1657 – Fixed platforms, walkways, stairways and ladders*
- *AS 1725 – Chain link fabric fencing*
- *AS 2156 – Walking Tracks*
- *AS 4100 – Steel Structures*
- *AS 4600 – Cold-formed steel structures*
- *National Construction Code*

3. DESIGNER QUALIFICATIONS

The Developer shall ensure that design shall only be carried out by properly qualified persons who are on the National Engineers Register (NER) or are eligible to be placed on the NER. The designers claimed area of competency shall be relevant to the type of design work being undertaken. The Developer shall submit evidence to Council's Engineer that the designer has all required qualifications prior to approval of any design work.

4. ENGINEERING DESIGN

4.1 INCLUSIONS

Unless stated otherwise, as a minimum, all design drawings submitted for approval shall include:

- Consultation with relevant Supply Authorities with regards to locating existing onsite

services as required and meeting their design requirements to facilitate the preparation of accurate design documentation.

- Engagement of a registered surveyor to undertake site surveys as required to facilitate the preparation of accurate design documentation. Where design relates to cadastral boundaries the designer shall engage a registered surveyor to 'calculate' the lot boundaries and provide a surveyor's lot base as base file input to design. The designer shall provide the surveyor's lot base to Councils engineer to evidence that this has been properly carried out.
- Engagement of a NATA registered geotechnical company to undertaken site geotechnical testing to facilitate the preparation of accurate design documentation.
- Identify parcels of land that require the establishment of easements and engagement of a registered surveyor to create easements as required.
- A full set of detailed design drawings suitable for use as construction drawings, meeting the requirements of all relevant Australian Standards and industry standards.
- A copy of all design calculations in an appropriate electronic format.
- Provision of a life cycle maintenance cost assessment over a time period specified by the Principal suitable for the infrastructure being designed. The assessment shall include equipment costs, maintenance costs and all operation costs such as service consumption charges.
- Provision of evidence of designer qualifications.
- Provide Safe Design Report in accordance with the requirements of SafeWork NSW.

4.2 DESIGN LIFE

The design lives of the components that together form the work shall be:

- Structural works – 50 years.
- Bridge works – 100 years.
- Flexible pavement works – 20 years.
- Rigid pavement works – 25 years.
- Civil works – 50 years.

SECTION 4 – SITE RESTORATION & LANDSCAPING

1. SCOPE

This Section of the Guidelines for Engineering Works outlines Council's requirements for site restoration and landscaping.

2. STANDARDS

Unless otherwise specified, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standard listed in this Section.

Standards relevant to this Section include, but are not limited to:

- *AS 1160 – Bituminous emulsions for the construction and maintenance of pavements*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 2303 – Tree stock for landscape use*
- *Managing Urban Stormwater: Soils and Construction – Volume 1 (NSW Blue Book)*
- *Managing Urban Stormwater: Soils and Construction – Volume 2A, Installation of services (NSW Blue Book)*
- *Managing Urban Stormwater: Soils and Construction – Volume 2D, Main road construction (NSW Blue Book)*
- *All development consent conditions*

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN10775 – Roundabouts Vegetation and Signage Policy*
- *EN12014 – Regular Tree Planting Details*
- *EN12045 – Passively Irrigated Street Tree Planting Details*
- *EN12046 – Urban Road Typical Layout & Verge Details in Greenfield Sites from 21 September 2023*
- *EN12050 – Open Space Vehicle Barrier & Access Details*

3. TOPSOILING

3.1 GENERAL

The minimum topsoil depth shall be the minimum depth specified in *Clause 3.4* of this Section or an absolute minimum of 100mm thick. Topsoil shall be spread on any area detailed in the approved drawings or specification, erosion and sediment control plan (ESCP)/soil and water management plan (SWMP) and to all disturbed areas.

Where site topsoil has been stripped and stockpiled, that topsoil shall generally be used for restoration of dryland grass areas in the development.

Prior to spreading, both stockpiled site topsoil and imported topsoil shall be tested, inspected and approved by Council's engineer, based on the requirements of *Clause 3.2* of this Section.

Where diesel oil, cement or other harmful material has been spilt on the subgrade or topsoil, the affected areas shall be excavated, and the contaminated soil disposed of in a suitable manner. Any such contaminated soil shall be replaced with site soil or imported topsoil as required to make up to the design levels.

3.2 TOPSOIL SPECIFICATION

The texture of topsoil shall be light to medium, i.e. capable of being handled when moist, but lacking cohesion so that it will fall apart easily when dry. Particle size distribution shall comply with the grading prescribed in Table 4.1.

pH shall be in the range of 6.0 to 7.0.

TABLE 4.1 – Topsoil Particle Size Distribution

AS Sieve Size (mm)	Percentage Passing by Mass
4.76	100
2.36	98 – 100
1.18	93 – 100
0.600	50 – 100
0.300	24 – 90
0.150	12 – 40
0.075	5 – 20

3.3 SUBGRADE PREPARATION

Where specified, any materials that shall be incorporated into the insitu soil shall be applied at this stage of soil preparation. Lime, if specified in the approved drawings or specifications, or directed to be placed by Council's engineer, shall be thoroughly cultivated into the in-situ soil prior to application of topsoil.

Prior to undertaking the subgrade preparation treatments required by this Section, the Developer shall ensure that subgrade has been prepared and approved to the requirements of *Section 5 – Earthworks*.

Subgrade cultivation for specified landscape treatments shall be as below:

- **Areas to be seeded, turfed, hydroseeded, hydromulched or mass planted -** cultivate areas to be so that subgrade surface soil can be freely worked to a minimum depth of 100mm to eliminate compaction and hard pans, remove all stones over 20mm and remove perennial weeds and rubbish from the surface.
- **Planting beds -** excavate clay subsoil, builder's debris and other deleterious material from the planting bed to a minimum depth of 300mm below the finished surface level of topsoil unless otherwise shown on the approved drawings. Shape subgrade to fall to subsoil drains. Prior to backfilling, the base of the planting beds shall be broken up to a minimum depth of 100mm. Construct subsoil drains where shown.
- **Ripline planting areas -** within those areas shown on the approved drawings as being ripline planted, each planting line shall then be ripped to a minimum depth of 500mm. All cultivations shall be parallel to final contours.

Trim surfaces to specified shape as cultivation ready for topsoiling.

3.4 SPREADING

After preparation of the subgrade surface, place topsoil as appropriate for the specified landscape treatments.

The finished surface of the topsoil shall be smooth, free of lumps of soil and left ready for

cultivating and planting.

The route of vehicles and plant passing over newly scarified or topsoiled areas shall be avoided or varied to avoid developing areas of excess compaction.

Topsoil areas, when finished, shall present smooth surfaces free of lumps of soil or stones and gradually blending into adjoining undisturbed ground. Where topsoiling is carried out adjacent to kerbs, footpaths, mowing strips or other hard-paved surfaces, the topsoil shall be finished flush with those surfaces unless otherwise specified.

Topsoil cultivation for specified landscape treatments shall be as below:

- **Areas to be seeded, hydroseeded, hydromulched or mass planted –** topsoil shall be placed and lightly compacted to a thickness of 100mm so that the finished surface of the topsoil is an even height above the prepared subgrade and conforms to the design levels as indicated on the approved drawings. On steep batters exceeding 1:6 slope, jute mesh or an approved equivalent shall be placed on the topsoil to stabilise the slope until vegetation establishes.
- **Areas to be turfed, planting beds and ripline planting areas -** topsoil shall be placed and lightly compacted to a thickness of 150mm so that the finished surface of the topsoil is an even height above the prepared subgrade and conforms to the design levels as indicated on the approved drawings.

4. MOWING AND MAINTENANCE

Irrespective of the time of the year, grass across the entirety of development shall be mowed to maintain grass at a height in the range 40 - 75mm during the development period. This includes existing grass within the site or grass established during works by seeding, turfing or hydroseeding/hydromulching.

During the period of the development, including the maintenance period, the Developer shall ensure that the grass growth is not endangered by the inflammable nature of any dead grass or other material present on the area. The Developer shall remove such inflammable grass or other material, if necessary, by immediately mowing and raking to minimise the fire risk.

Mowing and maintenance of all grass shall be the responsibility of the Developer until issue of a Subdivision Certificate, which will require the following conditions to be met:

- More than 90% germination and grass cover establishment to public reserves and/or designated landscaped areas.
- Germination and grass cover establishment to the requirements of the Consent Conditions for all other areas.

Dryland grass areas shall be kept green and actively growing until the above coverage requirements have been achieved; then the watering programme shall be gradually adjusted until the grass is hardened off to natural climatic conditions. Fully established dryland grass shall reflect, in appearance, the weather conditions prevailing at the time.

5. GRASSING

5.1 GRASS SEED

The seed used shall be of the best quality available, shall have good germination characteristics, be true to variety and comply with the mix types in Table 4.2. The seed shall be obtained from reputable seed merchants and the Developer shall produce satisfactory evidence of compliance with these requirements. Until used, any seed in the possession of the Developer shall be stored off the ground in a cool, dry place and shall not be stored any longer than required before being

used.

Table 4.2 – Seed Mixes for Various Applications

Mix Type and Purpose	Mix Details	Application Rate (kg/ha)
A. General irrigated areas (school grounds, general playing fields)	Alta Tall Fescue	110
	Kentucky Blue Grass	50
	White Clover	15
	Total	*175*
B. Enclosed ovals	Kentucky Blue Grass	160
	Chewings Fescue	40
	O'Connor's Strawberry Clover	15
	Total	*215*
C. Building surrounds, shopping centres	Kentucky Blue Grass	170
	Chewings Fescue	50
	O'Connor's Strawberry Clover	30
	Total	*250*
D. Dryland grass for non-irrigated areas in urban areas	Alta Tall Fescue	90
	Perennial Rye Grass	55
	Chewings Fescue	35
	White Clover	15
	Total	*195*
E. Roadside batters, underpasses, steep slopes with hydroseed/ hydromulch or jute mesh	Rye Corn	50
	'Black Winter' Perennial Rye Grass	50
	Wimmera Rye Grass	20
	White Clover	10
	Subterranean Clover	30
	Total	*160*
F. Temporary grass	Rye Corn	100
	'Black Winter' Wimmera Rye Grass	20
	Crimson Clover **	20
	Total	*140*

** Crimson clover to be inoculated with Group C Rhizobia inoculant and lime-coated prior to seeding taking place.

5.2 TOPSOIL SURFACE PREPARATION

Topsoil shall have been prepared in accordance with *Clause 3* of this Section prior to any seeding works.

Avoid removing any topsoil and ensure that at least the specified depth of the best available topsoil remains on the surface upon completion of the surface preparation.

A prepared mix of lawn seed starter fertiliser, N:P:K ratio 11:34:11, shall be spread evenly over

the prepared seed bed at a rate of 300kg per hectare (30gms/m^2). The fertiliser shall be lightly raked into the surface of the seed bed and applied at the time of sowing or not more than 48 hours before the seed is sown.

5.3 APPLICATION, WATERING, FERTILISING AND PROTECTION

Grass seeding may be carried out after approval of topsoiling works and seed mix has been given by Council's engineer.

The seed shall be sown on a calm day and applied in two equal sowings, in transverse directions. A machine designed for the purpose may be used. The surface shall be lightly raked to cover the seed. The seed bed shall be lightly rolled immediately after sowing.

After the application of seed, the whole of the area shall be uniformly watered. The volume of water to be applied at this time shall be equivalent to 10mm of rain. The Developer shall take care to avoid the formation of rills in the surface by applying water too rapidly.

All areas of seeding shall be maintained in a moist condition until satisfactory germination has occurred. This shall be achieved by applying the equivalent of a minimum of 15mm of rain in pulse applications in any period of seven days. Satisfactory germination shall be determined by Council's engineer by random sampling throughout the area.

After a satisfactory germination has been achieved, the seedlings shall be hardened off. This shall be done primarily by progressively decreasing the frequency and quantity of watering. This will depend largely on seasonal conditions.

If Council's engineer is of the opinion that excessive rilling has occurred in the surface, from whatever cause, the Developer shall re-prepare and re-sow the affected area, and if so directed, the Developer shall re-prepare and re-sow the area.

Allow for making over and reseeding all areas where the grass seed fails to germinate within two weeks from the date of original seeding.

Protect the newly sown areas against trespass and traffic until the grass is well established, using appropriate fencing or other measures.

It is expected that that an establishment period would not be less than 10 weeks. Council's engineer will consider the Developer's establishment of grass seeding as successful when:

- More than 90% germination and grass cover establishment has been achieved for public reserves and/or designated landscaped areas.
- Germination and grass cover establishment has been achieved to the requirements of the Consent Conditions for all other areas.

6. TURFING

6.1 TURF

The turf shall be sourced by an industry registered turf supplier in the cultivar/species specified or as directed by Council's engineer. Supply turf species certification to Council's engineer if requested.

Turf shall be delivered to the site within twenty-four hours after being cut and installed within thirty-six hours after being lifted from the nursery.

When turf is stored prior to laying, it shall be placed in a cool shaded location or covered with wet hessian. Stack turf in rolls as delivered.

Turf shall not be allowed to dry out at any stage from lifting to laying.

6.2 TOPSOIL AND SURFACE PREPARATION

Topsoil shall have been prepared in accordance with *Clause 3* of this Section prior to any turfing works.

The turf bed is to be raked and levelled to the specified fall/grades. There shall be no depressions, lumps, rocks etc within the turf area.

Avoid removing any topsoil and ensure that at least the specified depth of the best available topsoil remains on the surface upon completion of the surface preparation.

Fertiliser with N:P:K ratio 10:4:6 (approved equivalent to 'Multigro') shall be thoroughly mixed into the topsoil at a rate of 40g/m^2 prior to placing turf.

6.3 APPLICATION, WATERING, FERTILISING AND PROTECTION

Moisten prepared surface to a depth of 100mm before laying turf. Lay turf in a 'stretcher' pattern with joints staggered. Butt turf closely with a minimum of gaps. Edges of the turfed area and small gaps between shall be filled with an approved fine sand. On slopes, turf shall be laid diagonally.

The finished work shall be tamped/rolled with a turf roller to an even surface immediately after laying.

Water the turf areas whenever needed to maintain in a healthy condition. Particular attention shall be given to watering requirements in the initial establishment period.

Protect the newly laid areas against trespass and traffic until the grass is well established, using appropriate fencing or other measures.

Replace all areas where the turf has failed to provide a healthy grass cover within one month from the date of laying.

Council's engineer will consider the Developers establishment of turf successful when turf that has been in place for a minimum of three weeks is in healthy condition with root development to a depth of 100mm minimum.

7. HYDROSEEDING AND HYDROMULCHING

7.1 GENERAL

Unless otherwise specified, the technique to be employed for hydroseeding and hydromulching shall be the application by suitable equipment of a vegetative/bitumen emulsion mulch over a slurry of fertiliser and seed.

Seed mix shall be a seed mix from Table 4.2 of this Section as chosen by Council's engineer.

7.2 MATERIALS

Fertiliser to be used shall be N:P:K ratio 11:34:11 or suitable alternative. Fertiliser may be spread as part of the seeding operation, as a separate operation, or combined with the seeding and vegetative mulching.

Vegetative mulch shall consist of chopped cereal straw, wood fibre or suitable alternative over the entire seeded area. Under no circumstances will meadow hay be accepted.

Bituminous emulsion shall comply with the requirements of *AS 1160 – Bituminous emulsions for the construction and maintenance of pavements* and shall contain no petroleum solvents or other components toxic to plant life. Emulsion shall be suitable for cold spray application.

7.3 TOPSOIL AND SURFACE PREPARATION

Topsoil shall have been prepared in accordance with *Clause 3* of this Section prior to any hydroseeding or hydromulching works.

Avoid removing any topsoil and ensure that at least the specified depth of the best available topsoil remains on the surface upon completion of the surface preparation.

Fertiliser may be spread as part of the seeding operation, as a separate operation, or combined with the seeding and vegetative mulching.

7.4 HYDROSEEDING WITH NATIVE SEED

The species of seed indicated to require pre-treatment shall be placed in a calico bag and immersed in water kept at a temperature between 80^{o} C and 95^{o} C for a period of ten minutes. Do not boil. Then remove from heater and allow seed to soak for twenty-four hours. Treatment shall be carried out immediately before hydroseeding.

7.5 APPLICATION, WATER, FERTILISING AND PROTECTION

All hydroseeding shall be carried out on a front and the slurry shall be sprayed evenly over the area to ensure an even distribution of the seed mixture. Each front shall be completed before the next area is commenced. Application rates shall comply with Table 4.3.

TABLE 4.3 – Application Rates

Material	Application rate
Seed Mix	As specified in Table 4.2
Fertiliser	250kg of 11:34:11 fertiliser per hectare
Vegetative Mulch	250 bales per hectare (5 tonne)
Bitumen Emulsion	6000 litres per hectare

All hydroseeding and hydromulching shall be carried out on calm days and may be carried out in any of the following sequences -

- Hydroseeding and fertilising then straw mulching then bitumen spraying.
- Hydroseeding then fertilising then straw mulching then bitumen spraying.
- Hydroseeding then fertilising, bitumen and straw mulching.

Sufficient seed shall be placed in a suitable hydroseeding machine to prove seeding rate at least equal to that specified. The seed, water, fertiliser and vegetative mulch or combination thereof, shall be kept constantly agitated during the seeding operation.

Vegetative mulch shall be applied as a separate operation, either wet or dry, combined with the seeding and fertilising or combined with the bitumen emulsion.

Diluted bitumen emulsion shall be applied to the whole area, vegetatively mulched at the rate of 6000 litres per hectare. The emulsion shall be diluted by the addition of an equal volume of water prior to spraying. The emulsion shall be applied as a separate operation or combined with the vegetative mulching.

All areas of hydroseeding shall be maintained in a moist condition until satisfactory germination has occurred. This shall be achieved by applying the equivalent of a minimum of 15mm of rain in pulse applications in any period of seven days. Satisfactory germination shall be determined Council's engineer by random sampling throughout the area.

After a satisfactory germination has been achieved, the seedlings shall be hardened off. This shall be done primarily by progressively decreasing the frequency and quantity of watering. This will depend, to a large extent, on seasonal conditions.

If Council's engineer is of the opinion that excessive rilling has occurred in the surface, from whatever cause, the Developer must re-prepare and re-hydroseed or hydromulch the affected area.

Allow for making over and reseeding all areas where the grass seed fails to germinate within two weeks from the date of original seeding.

Protect the newly sown areas against trespass and traffic until the grass is well established, using appropriate fencing or other measures.

It is expected that that an establishment period would not be less than 10 weeks. Councils engineer will consider the Developer's establishment of grass seeding as successful when:

- More than 90% germination and grass cover establishment has been achieved for public reserves and/or designated landscaped areas.
- Germination and grass cover establishment has been achieved to the requirements of the Consent Conditions for all other areas.

8. DAMAGE TO EXISTING SURFACE COVER

Generally, all grassed areas outside of the required construction area or where indicated within the construction area on the approved drawings, existing grass shall be maintained in good condition.

Where existing grass or vegetation is damaged outside the required construction area, as a minimum, the Developer will fully remediate the damaged areas in full accordance with *Clauses 3, 4 and 5* of this Section.

9. TREE PLANTINGS

9.1 GENERAL

All tree plantings shall be the Developers responsibility until evidence of establishment and new growth is visually evident on all plantings. Any plantings in visually poor condition shall be replaced at the Developers cost.

9.2 REGULAR TREE PLANTINGS

Where regular tree plantings are specified on the approved plans, works shall be undertaken in accordance with standard drawing *EN12014.*

9.3 PASSIVELY IRRIGATED STREET TREE PLANTINGS

Where passively irrigated street tree plantings are specified on the approved plans, works shall be undertaken in accordance with standard drawing *EN12045.*

10. TESTING & SURVEY REQUIREMENTS

Where testing and survey items are specified by Consent Conditions or Council's engineer, the Developer shall arrange for the testing to be undertaken. Testing shall be treated as a hold point

in the development and subsequent works shall not proceed until approval has been given.

Where specified, tests shall be undertaken in accordance with Australian Standards by a NATA approved testing laboratory. All test results from the NATA approved testing laboratory shall be filed and provided to Council, regardless of the results of the testing.

10.1 MATERIALS

All materials shall be proven to be compliant with the requirements of this Section by provision of material specifications and/or NATA laboratory testing.

10.2 TESTS & SURVEY

- Onsite stockpiled topsoil testing by NATA laboratory.
- Imported topsoil testing by NATA laboratory.
- Bore hole backfill material testing by NATA laboratory.
- Level survey by registered surveyor and straightness inspection with Council.

10.3 TESTING SPECIFICATIONS

Where test or survey items listed in *Clause 10.2* of this Section are specified as a Development requirement, testing procedures shall comply with the requirements of this Clause. Tables 4.4 to 4.7 describe the required test types, results, tolerances and frequencies of testing.

TABLE 4.4 – Required Tests and Survey Description

Item	Required Tests and Survey Description
Onsite stockpiled topsoil testing	• Particle size distribution test in accordance with *AS 1289*. • pH test using method approved by Council's engineer.
Imported topsoil testing	• Particle size distribution test in accordance with *AS 1289*. • pH test using method approved by Council's Engineer.
Bore hole backfill material	• Particle size distribution test in accordance with *AS1289*.
Level and straightness compliance	• Survey undertaken by registered surveyor on finished levels (works as executed survey will be acceptable). • Thickness may be checked by Council's engineer at any time. • Inspection of straightness with Council's engineer.

TABLE 4.5 – Required Results

Item	Required Results
Onsite stockpiled topsoil testing (1)	• Particle size distribution to comply with *Clause 3.2* of this Section. • pH to comply with *Clause 3.2* of this Section.
Imported topsoil testing (1)	• Particle size distribution to comply with *Clause 3.2* of this Section. • pH to comply with *Clause 3.2* of this Section.
Bore hole backfill material (2)	• Particle size distribution to comply with *EN12045*.
Level and straightness compliance (3)	• Levels shall target design. • Thickness shall be the specified minimum. • Straightness shall be uniform and allow for ride-on mower maintenance.

(1) – if topsoil does not meet the particle size distribution requirements, then it shall be modified to meet requirements, an alternate imported topsoil be sourced, or special approval be obtained from Council's engineer in writing to use the topsoil. If pH is outside the specified range, the Developer will need to treat the topsoil to obtain a suitable pH after placement prior to any seeding, hydroseeding, hydromulching or turfing takes place as directed by Council's Engineer.

(2) – if material does not meet the requirements, an alternate material shall be sourced.

(3) – see Table 4.6 for tolerances.

TABLE 4.6 – Topsoil Level, Thickness and Straightness Tolerances

Layer	Item	Tolerance
Topsoil	Level	No more than 50% of all survey points to be outside of ± 20mm of design
		No more than 10% of all survey points to be outside of ± 50mm of design
	Thickness	- 0mm to + 50mm
	Straightness	20mm maximum departure from a 3m straight edge in any direction

TABLE 4.7 – Required Test Frequencies for NATA Laboratory Works

Item	Required Frequency
Onsite stockpiled topsoil testing	• Particle size distribution and pH tests shall be undertaken at whichever is the greatest of three tests or one test every 250m^3.
Imported topsoil testing	• Particle size distribution and pH tests shall be undertaken at whichever is the greatest of three tests or one test every 250m^3 of imported material.
Bore hole backfill material	• One test and inspection every 250m^3.

SECTION 5 – EARTHWORKS

1. SCOPE

This Section of the Guidelines for Engineering Works outlines Council's requirements for the design and construction of earthworks.

2. STANDARDS

Unless otherwise specified, materials and workmanship shall be in accordance with the latest relevant Australian Standard or other standard listed in this Section.

Standards include, but are not limited to:

- *AS 1141 – Methods for sampling and testing aggregates*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 3798 – Guidelines on earthworks for commercial and residential developments*
- *Environmental Protection Agency – Waste Classification Guidelines*

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN7883 – Trench Shielding Requirements*
- *EN7892 – Stormwater Pipe Bedding & Backfill Details*
- *EN7901 – Sewer Pipe Bedding & Backfill Details*
- *EN7904 – Water Pipe Bedding & Backfill Details*
- *EN12046 – Urban Road Layout & Verge Details in Greenfield Sites from 21 September 2023*
- *EN12047 – Earthworks Details at Subdivision & Dwelling Stages*

3. ENGINEERING DRAWINGS

3.1 GENERAL

Engineering drawing submissions shall include all information requested in *Section 1 – General, Clause 5*. The following Clause provides an outline of the earthworks details which shall accompany all design submissions.

3.2 PLAN

Plans of all proposed earthworks shall be drawn at a standard scale no greater than 1:500 and shall include the following:

- Lot boundaries and numbers.
- A benchmark within 100m of the development site, with survey co-ordinates shown.
- Street names and north point.
- Bar scales.
- Existing services, trees, structures, and other significant landmarks.
- All datum references to the Australian Height Datum.
- Cut/fill plan clearly showing cut/fill depths in coloured hatching at 250mm depth increments.
- Slope arrows clearly detailing the slope of all allotments perpendicular and parallel to the allotment frontage.
- Any areas to be filled or regraded shall be clearly identified on the engineering drawings.

Provision shall be made to ensure that no ponding of water occurs on adjoining properties due to filling or regrading.

- Existing and proposed contours with labels spaced at maximum 0.5m intervals.
- Location of soil test sites, and CBR values so determined.

4. CLEARING AND GRUBBING

For the full area of the site specified or shown on the approved drawings, prescribed materials, being fences, concrete and/or brick foundations and/or floors, structures of all descriptions, marked trees, shrubs, scrub, stumps, logs, bounders and roots, except those fences, structures, trees, shrubs and/or items directed to be retained, shall be cleared and/or wholly grubbed, and together with all lying and fallen timber, rubbish and debris of every description shall be removed from the site.

All materials cleared and/or grubbed shall become the property of the Developer, who shall adhere to the latest relevant environmental legislation for disposal of the materials.

All grubholes or other depressions occasioned by the clearing and/or grubbing work shall be backfilled with approved material and the area thoroughly compacted.

Every precaution shall be taken to prevent timber or other materials falling on and/or being deposited on private property, and the Developer shall remove any timber or other materials fallen and/or deposited.

5. IMPORTED AND EXPORTED MATERIAL REQUIREMENTS

The Developer shall be responsible for organising soil testing for any imported material at the source site and provision of a report classifying the waste in accordance with *EPA Waste Classification Guidelines*. The material shall be classified as Virgin Excavated Natural Material (VENM) or Excavated Natural Material (ENM) to be appropriate for use as a fill material onsite.

The Developer shall also be responsible for arranging testing as detailed above for any material to be exported from site to determine the material class, which shall determine how and where the material may be disposed of.

6. REMOVAL AND REPLACEMENT OF TOPSOIL

Topsoil shall be stripped from all areas to be disturbed by the works. The topsoil shall be stockpiled in approved locations for later re-spreading in accordance with *Section 4 – Site Restoration & Landscaping*. Grass shall be stripped off with the topsoil. Care shall be taken to avoid contamination by any other material.

7. SLOPE MANAGEMENT IN SUBDIVISIONS

7.1 GENERAL

Future developments in the Bathurst region are expanding into areas which have increased slopes across sites and will have to address the impacts of sloping land on streets, houses, and public spaces. The intent of this Clause is to ensure that development of land on these sloping sites is appropriately designed and constructed to respond to undulating topography.

Compliance with this Clause, which includes submission of a slope management plan, will be required when:

- Specified as a requirement by Council's engineer at application stage.
- Whenever an application is submitted for a subdivision and the existing land at pre-development stage has a natural slope greater than 10% at any point.

See standard drawing *EN12047* for additional details.

7.2 SLOPE MANAGEMENT PLAN OBJECTIVES

A slope management plan shall be used to demonstrate that a subdivision will respond to and respect the natural topography of the land. The plan shall demonstrate how the following considerations have been addressed:

- Maximum and minimum slopes for streets, allotments, and public/open spaces.
- Retaining walls have been used sparingly and appropriately with a maximum height of 1.2m.
- Drainage has been properly considered including collection and distribution to minimise erosion and any impacts on neighbouring properties, land and waterways.

7.3 SLOPE CLASSIFICATION

Table 5.1 below classifies different types of slope:

TABLE 5.1 – Slope Classification

Slope Category	Description
Flat	Slope less than 5%
Moderate Slope	Slope between 5% and 10%
Steep	Slope between 10% and 15%
Very Steep	Slope between 15% and 20%
Extremely Steep (not permitted post-development)	Slope greater than 20%

7.4 SLOPE MANAGEMENT PLAN REQUIREMENTS

A slope management plan shall typically include:

- A site description including plans of the site pre-development slopes and contours and categorise the slopes into areas of less than 10%, 10-15%, 15-20% and greater than 20%.
- A design response to the site description detailing how the proposed design will respond to the existing slopes.
- A description of how any land with a pre-development slope over 10% will be developed to suit adjacent land.
- A design response detailing how areas with pre-development slope over 20% will be reduced to a maximum of 20% post-development.
- A description including plans/diagrams detailing how the proposed development will complement the existing landform and mitigate any impacts of retaining walls.
- A geotechnical report and design by a suitably qualified geotechnical engineer to confirm the stability of the natural slope and suitability to be benched and retained.
- Details of all proposed roads including cross sections and longsections to demonstrate how existing slopes over 10% will be treated.
- Details of all proposed earthworks including cut/fill plans, retaining walls and drainage solutions for all existing areas with a slope greater than 10%.
- Details showing that all batters and other development perimeter earthworks treatments do not encroach into neighbouring private land, road reserves or open space areas.
- Evidence that finished subdivision will provide allotments suitable for dwelling construction.

8. BULK EARTHWORKS, RETAINING WALLS & ALLOTMENT SHAPING

8.1 GENERAL

The design and construction of bulk earthworks, retaining walls and allotment shape at subdivision and dwelling construction stages shall be in accordance with the requirements of this Clause.

8.2 SUBDIVISION STAGE

Bulk earthworks shall be designed and constructed in a manner that preserves natural scenic features whilst also managing the landform manipulation to ensure suitable conditions for development of the site.

See standard drawing *EN12047* for additional subdivision bulk earthworks requirements and allotment shaping options.

General conditions for bulk earthworks are as below:

- At application stage, the Developer shall submit accurate site surveys prepared by a registered surveyor to provide a clear and accurate representation of the contours of the land.
- At application stage, bulk earthworks plans including cut/fill details and slope management plans (where required) shall be provided to justify the need for changes to natural terrain (including the construction of any retaining walls) and demonstrate that the subdivision and subsequent development on allotments created by the subdivision will respond to and respect the natural scenic features of the land.
- A continuous minimum slope of 1% shall be provided from the front to the rear/rear to the front of all allotments to prevent the ponding of water at any point within the allotment.
- The maximum slope in any direction for all allotments shall be 20%.
- The maximum longitudinal grade for roads shall be as detailed in *Clause 4.5.2, Section 6 – Roads*.
- The maximum change in level permitted to the outer edge/extent/perimeter of the subdivision shall be 1m. This may be finished as a retaining wall or 1:4 batter. Where the edge is an existing road reserve, reserve to reserve continuous slope shaping will remain a requirement.
- All retaining walls shall be constructed from masonry materials and comply with maximum heights and minimum setbacks as specified by the DCP and engineering guidelines.
- All above conditions apply where only one allotment is to be constructed between reserves where relevant.

8.3 DWELLING CONSTRUCTION STAGE

Minor earthworks and retaining walls shall be minimised to maintain the characteristics of the developed allotment. This shall include the design and construction of split-level dwellings as required.

See standard drawing *EN12047* for additional dwelling construction minor earthworks and retaining walls requirements and options.

General conditions for minor earthworks and retaining walls are as below:

- At application stage, minor earthworks and retaining wall plans shall be provided to justify the need for use of retaining walls. Construction of retaining walls at dwelling stage not

permitted unless approved by Council at application stage.

- Designs requiring minor earthworks and retaining walls will be considered if there is a significant improvement to the dwelling and services installed at subdivision stage do not require adjustment. All services shall be out of the zone of influence of any structure.
- The maximum height of any single retaining wall shall be 1.2m. The maximum total retained height shall not exceed 1.2m total, regardless of the number of terraces constructed. Where adjacent offset walls impart force via the zone of influence to each other, the defined overall height of the wall shall be the sum of the walls.
- Where walls are constructed each side of a common allotment boundary and impart force via the zone of influence to each other, the defined overall height of the wall shall be the sum of the walls.
- Retaining walls on the high side allotment shall be designed and constructed to ensure that no zone of influence forces will be applied to a retaining wall 0.5m off the property boundary and 1.2m high (below subdivision level) on the low side allotment.
- Any single retaining wall over 1m high shall be structurally certified at both the design and construction stage by a properly qualified person on the National Engineers Registration. This shall also include proof that all services are outside the zone of influence of structures.
- Where retaining walls have been constructed within the allotment at subdivision stage to the maximum of 1.2m high, no additional retaining walls shall be constructed on the same boundary (rear or side boundary) at dwelling construction stage.
- All retaining walls shall be constructed from masonry materials.
- Drainage from rear of retaining wall shall be considered and outlet to a legal point of discharge.
- All above conditions apply where only one allotment is to be constructed between reserves where relevant.

9. EXCAVATION

9.1 GENERAL

Excavation shall be taken out to the dimensions and levels in the approved drawings and specifications. All spoil shall be deposited well clear of the excavation, which shall be maintained free of all debris, collapsed soil and spoil.

The Developer shall avoid taking out excess excavation beyond the dimensions, as defined in the approved drawings and specification. Where excess excavation occurs, the Developer shall make good with an approved material placed and compacted in layers not less than 100mm and not exceeding 250mm uncompacted thickness. Each layer shall be compacted to 98% of the standard maximum dry density when tested in accordance with *AS 1289*.

9.2 SERVICE TRENCH EXCAVATION AND BACKFILL

Service trenches shall be excavated in accordance with standard drawings *EN7892, EN7901* and *EN7904*. The Developer shall further excavate, where necessary, to allow the box sections and/or pipes/conduits to be properly handled, jointed, packed and to permit the free use of caulking tools and to facilitate backfilling around the box and/or pipe/conduit. The bottom of the trench shall be neatly trimmed to give the pipes a uniform bearing for the whole of the length of each pipe and allow the placing and compaction of not less than 100mm of approved bedding material as per the standard drawings listed above.

All trenches, including Supply Authority trenches, shall be backfilled with materials as specified

in standard drawings *EN7892, EN7901* and *EN7904,* in layers not exceeding 200mm uncompacted thickness with a vibrating plate or other approved method. This includes backfilling with approved stabilised sand (sand:cement mixed at 27:1) batched and delivered by an approved concrete plant under all existing roadways.

9.3 SERVICE PIT EXCAVATION AND BACKFILL

All service pits shall be excavated so that there is a minimum of 400mm between the outside of the pit and the side of the trench. The Developer shall further excavate, where necessary, to allow the pit to be properly handled, jointed, packed and to permit the free use of caulking tools and to facilitate backfilling around the pit.

All pits shall be backfilled with materials as specified in standard drawings *EN7892, EN7901* and *EN7904,* in layers not exceeding 200mm uncompacted thickness with a vibrating plate or other approved method. This includes backfilling with approved stabilised sand (sand:cement mixed at 27:1) batched and delivered by an approved concrete plant under all existing roadways.

9.4 EXISTING ROAD EXCAVATION

Where excavation is to be carried out through bituminous pavements, the bounds of the excavation shall be neatly saw-cut to form a uniform edge.

9.5 UNSUITABLE FOUNDATION MATERIAL

Where the foundation excavation level consists of material which, when compacted at optimum moisture content, would be of insufficient bearing value, or for any other reason, as deemed by a geotechnical supervisor or Council's engineer which constitutes unsuitable subgrade material, the Developer shall excavate to such further depth as directed, backfill with an approved suitable material, and provide a subgrade of acceptable bearing capacity.

Unsuitable material shall be replaced with granular or other approved fill material placed in layers not exceeding 200mm uncompacted thickness and compacted to 98% of the standard maximum dry density, when tested in accordance with *AS 1289*.

10. FILLING AND EMBANKMENTS

10.1 GENERAL

Filling and embankments shall be constructed to the lines, dimensions and levels shown on the approved drawings. The materials used for filling and embankments shall comply with the requirements of *Clause 10.2* of this Section generally, with minor amendments in certain circumstances as approved.

The material shall be placed in horizontal layers of an uncompacted thickness not less than 100mm and not exceeding 250mm. Each layer shall be compacted in accordance with the specification by thorough rolling with plant and approved methods.

Batters on embankments shall not have a slope greater than 1:4 unless otherwise shown on the approved drawings or approved by Council's engineer.

Filling and embankment construction works shall include:

- Preparation and compaction of the foundation upon which fill, and embankments shall be placed, including removal of unsuitable material and compaction to 98% standard maximum dry density.
- Placing and compacting of approved material to 98% standard maximum dry density.
- Placing and compaction of approved material in holes, pits and other depressions within the works area to 98% standard maximum dry density.

- Removal and replacement of material where required to achieve a minimum uncompacted thickness of 100mm.

10.2 MATERIAL REQUIREMENTS

The materials used for filling and embankments shall comply with the requirements of this Clause generally, with minor amendments in certain circumstances as approved, as detailed below:

- Particle size distribution shall be in accordance with Table 5.2.
- Other properties shall be in accordance with Table 5.3, with the following notes and amendments:

a) Where any structure, including pavements, are to be constructed above fill material being placed, the CBR values specified in Table 5.3 will be the minimum requirement. This may be adjusted for road pavements based on a certified pavement design.

b) Where fill material is being placed but no structures or pavements are to be constructed above the material, the maximum plasticity index for these general fill areas will be the smallest value of:

i. 25 as per Table 5.3.

ii. The plasticity index of the surrounding natural material.

TABLE 5.2 – Filling and Embankment Material Particle Size Distribution

AS Sieve Size (mm)	Percentage Passing by Mass
53	100
37.5	95 – 100
19	50 – 85
6.7	40 – 80
2.36	35 – 70
0.075	0 – 50

TABLE 5.3 – Filling and Embankment Materials Other Properties

Property	Test Method	Requirement
CBR_{4day} (1), characteristic value (%) upper 150mm layer lower layers	*AS 1289*	Minimum 10
Plasticity Index (PI)	*AS 1289*	Maximum 25
Maximum Dry Compressive Strength (MPa)	*AS 1289*	Minimum 2

(1) – For the fraction passing 19.0mm AS sieve. Compact test samples to 100% standard maximum dry density and soak for 4 days.

11. TRIMMING AND COMPACTION OF EARTHWORKS AND SUBGRADES

Earthworks and subgrades shall be trimmed and thoroughly compacted to 98% of the standard maximum dry density at an optimum moisture content of ± 2%, when tested in accordance with *AS 1289*. Compaction equipment shall be of a size and type suitable for the works.

All soft, unstable or unsuitable patches which develop during compaction, shall be removed and refilled with approved material and rolled until compacted.

Compaction shall continue until there is no visible movement of the subgrade under the deflection proof roll and a dry density has been achieved not less than 98% of the standard maximum dry density when tested in accordance with *AS 1289*.

After compaction the finished subgrade shall be parallel to the finished surface and at the specified depth below the grade line for the required area, to accommodate the appropriate lining, structure, road pavement or topsoil.

12. LOT FILLING/REGRADING

Any areas to be filled or regraded shall be clearly identified on the engineering drawings. Provision shall be made to ensure that no ponding of water occurs on adjoining properties due to filling or regrading. The Developer shall carry out the site regrading works shown on the approved drawings and shall carry out other site works as may be considered necessary by Council's engineer, to prepare areas or allotments to a condition suitable for building and/or reserves or to a condition suitable for recreational purposes.

Where batters are to extend onto adjoining properties the adjoining owner's consent is required.

The minimum lot grading shall be 1% towards a public road or interallotment drainage line, and a minimum of 100mm of topsoil placed over all fill areas.

The areas specified to be regraded shall be carried out by cut and/or fill, and/or by utilisation of surplus spoil compliant with *Clause 10.2* of this Section. Where insufficient filling is available from these sources, the Developer shall supply the required additional material compliant with *Clause 10.2* of this Section to complete the works.

The areas specified to be regraded shall be finished to the plan levels and/or grades, without abrupt changes of slopes and/or depressions, which may hold surface waters. The finished surface after compaction shall present a good true surface, free from rocks, clods, rubbish and any other deleterious materials. The removal and replacement of topsoil in accordance with *Section 4 – Site Restoration & Landscaping* shall constitute part of the regrading works.

13. TESTING & SURVEY REQUIREMENTS

Where testing and survey items are specified by Consent Conditions or Council's engineer, the Developer shall arrange for the testing to be undertaken. Testing shall be treated as a hold point in the development and subsequent works shall not proceed until approval has been given.

Where specified, Level 1 inspection, testing, supervision and reporting by a GITA will be required. Works that may trigger Level 1 GITA supervision include, but are not limited to:

- Subdivisions of 5 or more allotments.
- Bulk earthworks with cut or fill of more than 2m.
- Bulk earthworks on sites with poor geotechnical conditions. Examples of poor conditions include highly/extremely reactive clay sites, previously filled sites or sites with soft soils, loose sands, collapsing soils or highly erodible soils.

- Service trenches with a depth of 2m or greater.
- Removal of dense and/or deep-rooted vegetation.

As a minimum, where Level 1 GITA supervision is not specified, Level 2 GTA/NATA approved testing laboratory will be required. All test results from the Level 2 GTA/NATA approved testing laboratory shall be filed and provided to Council, regardless of the results of the testing.

13.1 MATERIALS

All materials shall be proven to be compliant with the requirements of this Section by provision of material specifications and/or Level 2 GTA/NATA laboratory testing.

13.2 TESTS & SURVEY

- Level 1 inspection, testing, supervision and reporting by a GITA for all earthworks including topsoil removal, placing of fill, compaction of fill, excavation and backfill of trenches (includes all service trenches) and proof rolling and testing of subgrades.
- Fill and embankment material testing prior to placement by Level 2 GTA or NATA laboratory (not required when works under Level 1 GITA supervision).
- Foundations and subgrades standard maximum dry density (SMDD) and California Bearing Ratio (CBR) testing by Level 2 GTA or NATA laboratory (not required when works under Level 1 GITA supervision).
- Filling and embankments SMDD and CBR testing for each compacted layer by Level 2 GTA or NATA laboratory (not required when works under Level 1 GITA supervision).
- Trench backfill supervision by Level 1 GITA or SMDD testing by Level 2 GTA or NATA laboratory.
- Level survey by registered surveyor and straightness inspection with Council's engineer.

Tests that are required for all development works:

- Imported and exported material waste classification testing in accordance with *EPA Waste Classification Guidelines*.

13.3 TESTING SPECIFICATIONS

Where test or survey items listed in *Clause 13.2* of this Section are specified as a Development requirement, testing procedures shall comply with the requirements of this Clause. Tables 5.4 to 5.8 describe the required test types, results, tolerances and frequencies of testing.

TABLE 5.4 – Required Tests and Survey Description

Item	Required Tests and Survey Description
Fill and embankment material	• All individual material tests required and described in *Clause 10.2* of this Section.
Foundations and subgrades/Final cut, fill and embankment layer	• Deflection testing - Proof roll with either: o A roller with a load intensity of 7 tonnes per metre width of roller. o A tandem axle rigid vehicle, having a maximum load of 15 tonne per axle group (8 tyres), 12 tonnes per axle group (6 tyres), or 10 tonnes per axle group (4 tyres). Single axle vehicles shall have maximum loads of 8.5 tonnes (dual tyres), or 5.4 tonnes (single tyres). • SMDD compaction test to *AS 1289.* • CBR test to *AS 1289*.
Each fill/ embankment layer	• SMDD compaction test to *AS 1289.* • CBR test to *AS 1289*.
Trench backfill	• SMDD compaction test to *AS 1289*.
Level and straightness compliance	• Survey undertaken by registered surveyor on finished levels (works as executed survey will be acceptable). • Compacted layer thickness may be checked by Council's engineer at any time. • Inspection of straightness with Council's engineer.

TABLE 5.5 – Required Results

Item	Required Results
Fill and embankment material (1)	• All properties to comply with *Clause 10.2* of this Section.
Foundations and subgrades/Final cut, fill and embankment layer (2)	• No movement of the pavement layer during deflection testing proof roll. • SMDD shall be 98% at ± 2% optimum moisture content. • CBR shall comply with *Clause 10.2* of this Section.
Each fill/ embankment layer (2)	• SMDD shall be 98% at ± 2% optimum moisture content. • CBR shall comply with *Clause 10.2* of this Section.
Trench backfill (3)	• SMDD shall be 98% at ± 2% optimum moisture content.
Level and straightness compliance (4)	• Levels shall target design. • Thickness shall be within tolerance. • Straightness shall be uniform.

(1) – if material does not meet the requirements, then it shall be modified to meet requirements, an alternate imported material be sourced, or special approval be obtained from Council's engineer in writing to use the material.

(2) – failure to achieve any of the required results means non-compliance for that layer and any subsequent layers.

(3) – failure to achieve any of the required results means non-compliance for the trench, 50m in each direction of the failed test or between the two service pits.

(4) – see Table 5.6 for tolerances.

TABLE 5.6 – Earthworks Level, Thickness and Straightness Tolerances

	Item	Tolerance
Earthworks	Level	No more than 50% of all survey points to be outside of ± 20mm of design
		No more than 10% of survey points to be outside of ± 50mm of design
	Thickness	Uncompacted layer thickness to be minimum 100mm and maximum 250mm
	Straightness	20mm maximum departure from a 3m straight edge in any direction

TABLE 5.7 – Required Test Frequencies for NATA Laboratory Works

Item	Required Frequency
Fill and embankment material	• One test and inspection every 500m^3 for in-situ material after initial approval is given by Council's engineer. • One test and inspection every 250m^3 for imported material.
Foundations and subgrades/Final cut, fill and embankment layer	• SMDD tests shall be undertaken at frequencies specified in Table 5.8. • CBR tests shall be undertaken at frequencies specified in Table 5.8.
Each fill/ embankment layer	• SMDD tests shall be undertaken for each layer at frequencies specified in Table 5.8. • CBR tests shall be undertaken for each layer at frequencies specified in Table 5.8.
Trench backfill	• SMDD tests shall be undertaken for every second layer with the following requirements: o One test every 40m of trenching, including at least one test between all service pits/changes in direction. o The testing location will be randomly changed from the location of the previous test within the same trench.

TABLE 5.8 – Foundations/Subgrades and Filling/Embankments Testing Frequency

Minimum testing frequency based on lot area:			
> 5000m^2	**1000-5000m^2**	**500-1000m^2**	**50-500m^2**
1 per 1000m^2 (minimum 10)	1 per 500m^2 (minimum 5)	1 per 250m^2 (minimum 3)	1 per 100m^2 (minimum 2)

SECTION 6 - ROADS

1. INTRODUCTION

This Section of the Guidelines for Engineering Works outlines Council's requirements for the design and construction of roadworks.

2. STANDARDS

Unless otherwise specified or approved, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standards listed in this Section.

Standards include, but are not limited to:

Road/Pavement Design:

- *AS 1158 – Lighting for roads and public spaces*
- *AS 1348 – Glossary of terms – Roads and traffic engineering*
- *AS 1428 – Design for access and mobility*
- *AS 1742 – Manual of uniform traffic control devices*
- *AS 1743 – Road signs - Specifications*
- *AS 1744 – Standard alphabets for road signs*
- *AS 1906 – Retroreflective materials and devices for road traffic control purposes*
- *AS 2150 – Hot mix asphalt – A guide to good practice*
- *AS 2890 – Parking facilities*
- *AS 3845 – Road safety barrier systems and devices*
- *AS 4049 – Paints and related materials*
- *AS 4282 – Control of the obtrusive effects of outdoor lighting*
- *AS 5100.2 – Bridge Design – Design Loads*
- *AS 60598 – Luminaires*
- *Austroads Guide to Road Design – Part 1 to Part 8*
- *TfNSW Supplement to Austroads Guide to Road Design – Part 1 to Part 8*
- *Austroads Guide to Pavement Technology – Part 2: Pavement Structural Design*
- *TfNSW Supplement to Austroads Guide to Pavement Technology – Part 2: Pavement Structural Design*

Road/Pavement Construction:

- *AS 1141 – Methods for sampling and testing aggregates*
- *AS 1160 – Bituminous emulsions for the construction and maintenance of pavements*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 2008 – Bitumen for pavements*
- *AS 2150 – Hot mix asphalt – A guide to good practice*
- *AS 2157 – Cutback bitumen*
- *AS 2341 – Methods of testing bitumen and related roadmaking products*
- *AS 2758 – Aggregates and rock for engineering purposes*

- *AS 2891 – Methods of sampling and testing asphalt*
- *Austroads Guide to Pavement Technology*
- *TfNSW QA Specification 3051: Granular Pavement Base and Subbase Materials*
- *TfNSW QA Roadworks Specifications:*
  - R82 – Lean-mix Concrete Subbase
  - R101 – Cold Milling of Road Pavement Materials
  - R106 – Sprayed Bituminous Surfacing (with Cutback Bitumen)
  - R107 – Sprayed Bituminous Surfacing (with polymer Modified Bitumen)
  - R109 – Bituminous Slurry Surfacing
  - R111 – Sprayed Bituminous Surfacing (with Bitumen Emulsion)
  - R112 – Sprayed Bituminous Surfacing (for Enrichment & Rejuvenation)
  - R116 – Heavy Duty Dense Graded Asphalt
  - R117 – Light Duty Dense Graded Asphalt
  - R118 – Crumb Rubber Asphalt
  - R126 – High Modulus Asphalt (EME2)
  - R131 – Guide Posts
  - R132 – Safety Barrier Systems
  - R142 – Retroreflective Raised Pavement Markers
  - R143 – Signposting
  - R145 – Pavement Marking (Performance Based)

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN7876 – Kerb and Gutter and Layback Details*
- *EN7877 – Perambulator Crossing Details*
- *EN7878 – Street Intersection Median Island*
- *EN7880 – Street Sign Details*
- *EN7881 – Rural Access Details and Concrete Drain Details*
- *EN7882 – Urban Access Details*
- *EN7885 – Urban Road Verge Allocation Details Pre-September 2023*
- *EN10775 – Roundabouts Vegetation and Signage Policy*
- *EN12045 – Passively Irrigated Street Tree Planting Details*
- *EN12046 – Urban Road Typical Layout and Verge Details in Greenfield Sites from 21 September 2023*

3. ENGINEERING DRAWINGS

3.1 GENERAL

Engineering drawing submissions shall include all information requested in *Section 1 – General, Clause 5*. The following section provides an outline of the road details which shall accompany all design submissions.

3.2 PLAN

Plans of all proposed roadworks shall be drawn at a standard scale no greater than 1:500 and

shall include the following:

- Lot boundaries and numbers.
- Road centreline chainages, radii, tangent points and deflection angles.
- A benchmark within 100 m of the development site, with survey co-ordinates shown.
- Street names and north point.
- Bar scales.
- Existing services, trees, structures, and other significant landmarks.
- Proposed service crossings.
- Existing and new easements.
- Road reserve and carriageway width.
- All datum references to the Australian Height Datum.
- Symbol legend.
- Radii on kerb returns and kerb lines.
- Vehicular crossings (both urban and rural).
- Existing and proposed contours.
- Proposed location of all street signs and pavement markings.
- Location of soil test sites, and CBR values so determined.
- Concrete paths.
- Cut and fill areas.
- Building envelopes.

3.3 LONGITUDINAL SECTION

A longitudinal section of the centreline of the roads shall be supplied at a standard scale no greater than 1:500 horizontally with a vertical exaggeration of 2 or 5.

The longitudinal section of the road centreline shall include chainages, reduced levels at the existing and design surfaces, design grades, length of vertical curves, and location and type of services.

Longitudinal levels shall be taken at 20m intervals and at all intermediate changes of grade.

Longitudinal sections and cross-sections shall be taken along existing intersecting roads for a sufficient distance (approximately 50m) to enable kerb returns, dish crossings and any necessary drainage to be designed.

3.4 CROSS-SECTIONS

Cross-sections shall be supplied at intervals not exceeding 20m for straights and 10m at curves, at a standard no greater than 1:200 horizontally with a vertical exaggeration of 2 or 5. Cross-sections shall show chainage, reduced level of existing surface, design levels of pavement, kerb, gutter and concrete paths.

Cross-sections shall not be terminated at the property alignment but shall be levelled sufficiently beyond the road boundaries, to enable batters of cutting and embankment to be shown.

A typical cross-section is to be included showing the following information:

- Crossfalls on carriageway and verge.
- Type of kerb and gutter.
- Depth, type of material to be used, compaction required for each layer of pavement where greater than an absolute minimum of 100% standard maximum dry density.
- Subgrade depth and design CBR.
- Subsoil drainage.
- Concrete paths.
- Type of surfacing.

3.5 KERB RETURNS

Kerb profiles shall be shown for all kerb returns and cul-de-sac bulbs. A scale of 1:50, 1:100 or 1:200 horizontally with a vertical exaggeration of 2 or 5 is recommended.

3.6 INTERSECTION DETAILS

A contour plan shall be provided at all proposed intersections, roundabouts, and cul-de-sac bulbs. The contour interval shall be selected to show variations in the design pavement surface levels, and so that the direction of surface runoff can be visually determined. A plan scale of 1:50, 1:100 or 1:200 with a contour interval of 0.1 metres is recommended.

3.7 SUPPORTING INFORMATION

The following supporting information is to be submitted with the Engineering drawings:

- A copy of the geotechnical site investigation report, including test results.
- Pavement design calculations.
- A certification from the designer responsible for the pavement design.

3.8 ROAD DEDICATION

Where a survey is carried out for the purposes of a development and it is found that the constructed road falls outside the road reserve and into the development area, such land is to be dedicated as a public road as it is currently fenced, or if unfenced, a minimum of 5.5 metres from the edge of the road formation as constructed, for road purposes.

4. ROAD DESIGN STANDARDS

4.1 ROAD HIERARCHY

In all areas, a road hierarchy must be established to ensure that a safe and efficient environment is provided for motorists and pedestrians. The road network shall be designed to passively discourage through traffic in residential areas, by creating a noticeable difference in speed environment and geometric characteristics relative to arterial routes.

Roads shall be designed for the maximum likely traffic volumes at the end of the specified design life, using the growth factors recommended in *Section 7 "Design Traffic" of Austroads Guide to Pavement Technology – Part 2: Pavement Structural Design*.

Throughout the road system, roads shall only connect with other roads of the same class, or up to two levels removed in the hierarchy.

The following classes of road detailed in Table 6.1 below have been adopted for use in areas administered by Council:

Table 6.1 - Road Hierarchy

Class of Road	Max. No. of Dwellings Served	Equivalent Standard Axles	Frontage Access	Design Speed Environment (km/h)
Residential				
Local Distributor	700	1.0×10^7	Limited	60 - 80
Local Collector	300	6.0×10^5	Yes	60
Local Access	100	2.0×10^5	Yes	50
Local Access (Open Space)	20	2.0×10^5	Yes	50
Minor Cul-de-sac	15	5.0×10^4	Yes	30
Rural Village Street	5	1.0×10^4	Yes	50
Industrial		1.0×10^7	Yes	40 – 60
Rural		1.0×10^7	Yes	80 – 100
Rural Residential		1.0×10^7	Yes	60

4.2 SPEED ENVIRONMENT

4.2.1 Speed Limits

Are determined by *Transport for NSW* and are typically 100km/h on highways and rural roads, 60km/h on local distributors, and 50km/h on residential streets. A speed limit of 40km/h applies within school zones for restricted periods.

4.2.2 Speed Environment

Is defined as the speed at which the 85th percentile driver will travel on the road network and is largely controlled by design elements such as horizontal road geometry. Safe operating conditions are achieved by ensuring that sight distance is adequate for the speed environment thus created.

Table 6.1 above indicates the design speed environment of the road hierarchy in residential and rural residential areas.

4.3 KERB & GUTTER

An approved sealed pavement, including kerb and gutter, shall be provided to all classes of road having speed limits of 80km/h or less. It should be noted that Rural Residential roads are normally provided with a sealed shoulder, incorporating full depth pavement, in lieu of kerb and gutter.

Where it is considered impractical to construct an isolated section of kerb and gutter and road pavement, Council will require the Developer to pay a contribution in lieu of construction, based on the estimated full cost of the works calculated by Councils engineer.

Note that sealed shoulders are only permitted where stormwater velocity on the road shoulder is kept below 2m/s in the 5% AEP event. In cases where this velocity is exceeded, the shoulder shall incorporate a concrete lined edge drain.

Table 6.2 below outlines the requirement for the different classes of kerb and gutter shown on standard drawing *EN7876*.

Table 6.2 - Road Edge Treatments

Road Edge Treatment	Used For
1.0m wide sealed shoulder	• Rural Residential roads • Rural roads
Upright/Barrier Kerb and Gutter	• Local Distributor roads • Local Collector roads • Adjacent to public reserves
Roll Kerb and Gutter	• Local Access roads
Semi-Mountable Kerb	• Adjacent to Medians, Traffic Islands and Roundabouts

4.4 CROSS SECTIONS

4.4.1 Standard Road Widths

Tables 6.3.1 and 6.3.2 below detail the cross-section characteristics which Council considers necessary to accommodate design traffic. The Director of Engineering Services will consider variations to the standards where it can be demonstrated that such departure enhances the amenity of the locality, retains an appropriate road hierarchy and the verge can accommodate services, street trees and concrete paths.

Carriageway widths are measured from the invert of kerb. The carriageway widths shown in Tables 6.3.1 and 6.3.2 include the width of all traffic and parking lanes.

Table 6.3.1 – Standard Road Widths for Brownfield Subdivisions and Greenfield Subdivisions Submitted Prior to 21 September 2023

Class of Road	Width of Road Reserve	Verge Width	Carriage way Width	Traffic Lanes	Parking Lanes	Seal Width	Formation Width	Shoulder Width
Residential								
Local Industrial	22	2 / 4.5	13.0	2 / 3.5	2 / 3.0			
Local Distributor	22	2 / 4.5	13.0	2 / 3.5	2 / 3.0			
Local Collector	20	2 / 4.5	11.0	2 / 3.0	2 / 2.5			
Local Access (including cul-de-sac)	17	2 / 4.5	8.0	2 / 3.0	2 / 1.0			
Local Access (Open Space)	10.5	1 / 4.5	6	2 / 3.0	-			
Rural Village *(1)*	20		6.5	3.25		6.7	7.7	0.5/0.5
Rural Residential *(2)*	20		6.5	3.25		8.5	10.5	2 / 2
Rural *(3)*	20		7.0	3.5		9.0	11.0	2 / 2
Pedestrian Facilities								
Pathway	4		1.5					
Cycleway	4		2.5					

(1) – Extend seal 100mm beyond carriageway into shoulder each side of road. Remainder of 0.5m shoulder to remain unsealed each side of road. Design pavement to full extend across

shoulder excluding seal.
(2) – Shoulder to be sealed 1m off carriageway, 1m furthest from carriageway to be unsealed each side of road. Design pavement to full extend across shoulder excluding seal.
(3) – Shoulder to be sealed 1m off carriageway, 1m furthest from carriageway to be unsealed each side of road. Design pavement to full extend across shoulder excluding seal. Information shown not applicable to a proclaimed Main Road.
* Shoulder widths for all rural class roads to be increased to 3m where barrier centrelines are marked on the road.
* Where a DCP map shows a cycleway or shared path, increase the verge width from 4.5m to 6m on the cycleway/shared path side – the carriageway will not be centrally located.

Table 6.3.2 – Standard Road Widths for Greenfield Subdivisions Submitted After 21 September 2023

Class of Road	Width of Road Reserve	Verge Width	Carriage way Width	Traffic Lanes	Parking Lanes	Seal Width	Formation Width	Shoulder Width
Residential								
Local Industrial	22	2 / 4.5	13.0	2 / 3.5	2 / 3.0			
Local Distributor	25	2 / 6.7	11.6	2 / 3.5	2 / 2.3			
Local Collector	22.1	1 / 6.25 & 1 / 4.75	11.1	2 / 3.25	2 / 2.3			
Local Access (including cul-de-sac)	18.5	2 / 4.75	9.0	2 / 3.0	2 / 1.5			
Local Access (Open Space)	11.25	1 / 4.75	6.5	2 / 3.25	-			
Rural Village *(1)*	20		6.5	3.25		6.7	7.7	0.5/0.5
Rural Residential *(2)*	20		6.5	3.25		8.5	10.5	2 / 2
Rural *(3)*	20		7.0	3.5		9.0	11.0	2 / 2
Pedestrian Facilities								
Footpath	4		1.5					
Cycleway	4		2.5					
Shared Path	12		3.0					

(1) – Extend seal 100mm beyond carriageway into shoulder each side of road. Remainder of 0.5m shoulder to remain unsealed each side of road. Design pavement to full extend across shoulder excluding seal.
(2) – Shoulder to be sealed 1m off carriageway, 1m furthest from carriageway to be unsealed each side of road. Design pavement to full extend across shoulder excluding seal.
(3) – Shoulder to be sealed 1m off carriageway, 1m furthest from carriageway to be unsealed each side of road. Design pavement to full extend across shoulder excluding seal. Information shown not applicable to a proclaimed Main Road.
* Shoulder widths for all rural class roads to be increased to 3m where barrier centrelines are marked on the road.
* Road reserve widths detailed include allowance for 1.5m footpaths and/or 3m shared paths within road reserve as required for class of road.
* See standard drawing *EN12046* for urban road layout and verge allocation details.

4.4.2 Pavement Crossfall

The standard crossfall on bituminous pavements is 3% from a central crown. For urban roads, crossfalls of up to 5% may be used in special circumstances to help with intersection design. For rural roads, crossfalls of up to 7% may be used for super-elevated curves.

Super-elevation is not normally provided, but where design speeds so require, the super-elevation of horizontal curves shall comply with *Austroads Guide to Road Design – Part 3: Geometric Design* and *TfNSW Supplement to Austroads Guide to Road Design – Part 3*.

In the cases where crossfall from a central crown is not feasible, then one-way crossfall shall be permitted. One-way crossfall shall be nominally at a grade of 3%, up to an absolute maximum of 5% in isolated cases. One-way crossfalls towards the gutter are required on any split-level carriageways.

Any proposal to vary these standards will require approval from the Director of Engineering Services.

4.4.3 Offset Crown

Where site conditions dictate that it is uneconomical to have the crown located on the centre of the road, the crown may be shifted towards the higher side provided that the offset crown is located on a traffic or parking lane line to prevent vehicles travelling in a defined traffic lane from having wheels each side of the offset crown.

4.4.4 Footpath, Cycleway & Shared Path Crossfalls

In areas where the verge is to be totally paved from the kerb line to the adjacent property boundary, the crossfall shall be 2% falling to the kerb.

All other areas, whether verge is unpaved or partially paved, the crossfall shall be 4% falling to the kerb.

4.4.5 Batters

All roads shall be cleared to the width of the road reservation, or to a width sufficient to permit cut and fill batters, whichever is the greater.

For urban roads, batters shall not be steeper than 1:4 (vertical:horizontal) in cuttings, and 1:4 in embankments. For rural roads, batters shall not be steeper than 1:2 (vertical:horizontal) in cuttings, and 1:3 in embankments. Exceptions will require the approval of Councils engineer.

Any cutting or filling undertaken by the Developer, which is designed to retain a structure, or could possibly undermine or remove the support of any existing structure, will require the construction of a retaining wall. Plans and design calculations shall be submitted to Councils engineer for approval before the commencement of construction.

4.4.6 Split-Level Carriageways

Split level carriageways will only be considered where justified through provision of slope management and bulk earthworks plans in accordance with *Section 5 – Earthworks, Clauses 7 & 8*. Split carriageways will only be permitted where these plans provide evidence that the overall development is improved by their use.

Where approved, the width of the road reservation shall be increased to accommodate the standard width verges, as well as the approved carriageway and median widths.

Long lengths of split-level road will not be permitted, nor may this type of construction be carried across street intersections.

Carriageways shall be widened to permit the maximum dimension emergency and service vehicles to have free and unimpeded access, if vehicles are parked parallel to the kerb line. The width of the carriageway and median shall be determined in consultation with the Director of Engineering Services.

The median may include a permanently retained batter not steeper than 1:6 to allow regular maintenance to be undertaken. Where minimum batter slopes cannot be achieved, retaining walls shall be designed to accommodate the SM1600 road traffic loadings specified in *AS 5100.2*.

Determination of whether safety barriers are warranted, and their design and construction shall be in accordance with *Austroads Guide to Road Design – Part 6: Roadside Design, Safety and Barriers* and *TfNSW Supplement to Austroads Guide to Road Design – Part 6*.

4.4.7 Cul-de-Sacs

Cul-de-sacs shall be constructed so that a minimum kerb-line radius of 9.5m is achieved from the centre of the cul-de-sac. The boundary of the road reserve shall be curved with a radius to suit the relevant verge width.

Where the head of the cul-de-sac is located on the low side of the road, special provision shall be made to convey overland storm water flows through easements or drainage reserves with a floodway in accordance with standard drawing *EN9161*.

Rural cul-de-sacs shall have a minimum radius (to edge of carriageway) of 12.5m, plus an additional 1m sealed shoulder. The boundary shall be curved with a radius to suit the relevant verge width.

Turning heads may be acceptable in lieu of cul-de-sac heads in some instances, where approved by the Director of Engineering Services.

4.4.8 Half-Road Construction

Where proposed subdivisions or developments front one side of an existing sealed road, the existing pavement is assessed as having adequate strength and the vertical alignment complies with current standards, the existing pavement may be retained. The remainder of the half-width construction can then be carried out to the standard of the existing road. In all cases, the new seal shall extend to the crown of the road to avoid irregularities.

Where existing pavement strength or road alignment is unsatisfactory, pavement construction shall be the full width of the carriageway.

4.5 GEOMETRIC STANDARDS

The following guidelines have been developed to ensure that carriageways provide:

- Smooth, safe and trafficable horizontal and vertical alignments.
- Adequate sight distance.
- Suitable vehicular and pedestrian access to building allotments.
- Measures to prevent ponding of stormwater.
- A path for overland flow in major storm events.

4.5.1 Horizontal Alignment

Where an obstruction off the pavement, such as a street tree, restricts sight distance, the minimum radius of curvature shall be selected as the stopping sight distance for the adopted design speed.

However, it is preferred that the radius adopted shall be determined using intermediate sight distance criteria as described in *Austroads Guide to Road Design – Part 3: Geometric Design* and *TfNSW Supplement to Austroads Guide to Road Design – Part 3*.

4.5.2 Longitudinal Centreline Grading

Local distributor roads, and those which are likely to be used as bus routes, shall have a maximum longitudinal centreline grading of 8%. All other roads shall be designed with a maximum grade of 12%. However, grades of up to 16% may be permissible on straights for a maximum distance of 150 metres, depending on traffic volume and type.

At street intersections, a maximum longitudinal grade of 5% shall be used on the through road to ensure a maximum crossfall of 5% to the side road. The maximum longitudinal grade for side roads where stop or give ways signs are used shall be 3%.

A maximum grade of 8% shall be used at locations of poor visibility, on horizontal curves of radius 15metres or less and at kerb returns. Cul-de-sac turning heads are limited to maximum grades of 5%.

Gutters shall have a minimum longitudinal grading of 1% for all roads, however consideration shall be given to increasing this grade where changes of direction or drainage concentration occurs.

Proposals to vary the maximum and minimum permissible grades over short road lengths will be considered by Councils engineer, however such approvals will be strictly limited, and shall be sought prior to incorporating these variations in the road design.

When designing roads on steep grades, considerable attention shall be given to alternative road layouts, due to the cost of constructing special stormwater structures on steep grades.

4.5.3 Vertical Curves

Vertical curves shall be provided at all changes in grade. Where possible, vertical curves should coincide with horizontal curves.

The length of crest and sag vertical curves shall be determined from *Austroads Guide to Road Design – Part 3: Geometric Design* and *Transport for NSW Supplement to Austroads Guide to Road Design – Part 3*.

4.5.4 Intersections and Roundabouts

Intersections shall be designed in accordance with *Austroads Guide to Road Design – Parts 4 and 4A* and *TfNSW Supplement to Austroads Guide to Road Design – Parts 4 and 4A*.

Roundabouts shall be designed in accordance with *Austroads Guide to Road Design – Part 4B* and *TfNSW Supplement to Austroads Guide to Road Design – Part 4B*. All roundabouts shall be provided with the following as a minimum:

- A centre island with:
  - An inner section for landscaping, signage and lighting delineated by barrier kerb to

prevent vehicles entering.

- A mountable outer section with a minimum width of 1m from the face of barrier kerb of the inner section.
- The inner section shall have a water service and meter, a grated inlet stormwater pit and subsoil drainage to the inside circumference of the barrier kerb a minimum of 600mm deep.
- The inner section shall be landscaped/vegetated and irrigated in accordance with *Clause 8.1* of this Section and *EN10775*.

- Raised splitter islands on all approaches including pedestrian and bicycle refuge. Painted medians shall be provided on approach to the splitter islands. Splitter islands to be infilled with coloured concrete specified by Councils engineer.
- Kerb returns fully constructed with barrier kerb.
- Pram ramps aligned with all splitter island refuges, both sides of the road (8 total per roundabout).
- Signage.
- Pavement marking including give way lines, lane lines and arrows.
- Reflective white paint to all mountable kerbs and islands.

4.5.5 Overtaking and Turning Lanes

Overtaking (or auxiliary) and turning lanes shall be provided where recommended by *Austroads Guide to Road Design – Part 3: Geometric Design* and *TfNSW Supplement to Austroads Guide to Road Design – Part 3*.

4.5.6 Kerb Returns

Kerb returns shall be designed for all roads to ensure a smooth trafficable surface around the return. The maximum longitudinal kerb grade and maximum pavement crossfall shall not exceed permissible values in *Clause 4.5.2* of this Section.

Kerb returns shall be a minimum 8m radius; however, this shall be increased as necessary to accommodate the turning circle of large vehicles and public transport.

As far as practical, low points within the kerb return shall be avoided to prevent the use of pits with curved lintels.

4.5.7 Vehicular Access

Roads shall be located and designed so that vehicular access is readily available to all allotments using the standardised design vehicles “B85” for domestic accesses and “B99” for all accesses other than domestic as detailed in Appendix C of *AS 2890.1*.

At intersections, roads and building allotment layouts shall be designed so that driveway access is not required directly opposite the intersection or within 6m either side of the prolongation of the side road property line on any terminating road, or within 6m of either kerb return tangent point.

See *Clause 4.7* of this Section and standard drawings *EN7881* and *EN7882* for additional details.

4.5.8 Right of Carriageway (R.O.W.)

A maximum of three (3) allotments shall be serviced by a right of carriageway for reasons of

practical management, control and maintenance. Therefore, by definition, the primary allotment provides the right of carriageway and two (2) only additional allotments benefit. All right of carriageways shall be constructed in accordance with *Clause 4.7* of this Section.

4.5.9 Staged Road Construction

Where roads are constructed in stages of a subdivision, a permanent-type barricade shall be constructed at the end of that stage to warn motorists of the terminating road and shall only be removed upon commencement of the adjoining stage.

A temporary gravel turning area of minimum radius 9.5 metres shall be constructed at the end of the terminating roadway to permit the manoeuvring of service vehicles.

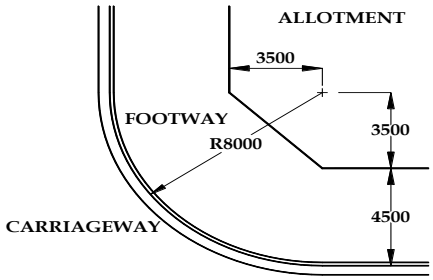
4.5.10 Curved Road Reserve Boundaries and Fencing

Road boundaries may be curved, but where they are to be fenced as chords, these shall be not less than 10 metres in length. Where several such chords occur adjacent to each other, they shall be of equal length where practicable.

4.5.11 Corner Splays

Corner splays shall be incorporated on corner allotments to provide:

- Sufficient space for utility service allocations in accordance with standard drawings *EN7885 and EN12046*.
- A full width verge for pedestrian movement.
- Sight distance for vehicles to Austroads standards.



These splays shall be designed to provide the above, however, shall nominally measure 3.5m parallel to front and side boundaries of the corner allotment, and having a diagonal approximately 5.0m in length.

4.6 FOOTPATHS, CYCLEWAYS & SHARED PATHS

Where conditions of development consent require the construction of concrete footpaths, cycleways or shared paths these shall be designed and constructed in accordance with standard drawings *EN7879 and EN12046*. Perambulator ramps are required at all kerb crossings in accordance with standard drawing *EN7877*. Strategic footpaths as identified on Map 5 in Appendix 1 of the Bathurst Community Access and Cycle Plan 2011 shall be a minimum of 1.5m wide.

Footpath grades shall be in accordance with *AS 1428*. The maximum grade to be used in pathways providing access to public gardens and reserves shall be 7%.

Where footpath, cycleways or shared paths are to be located within a floodway, they shall be located centrally in the reserve. Drainage shall be provided to ensure stormwater will not overflow onto adjoining properties. See standard drawing *EN9161* for details.

The location of footpaths, cycleways and shared paths shall be shown on the engineering drawings; however detailed designs will generally not be required.

4.7 DRIVEWAY CONSTRUCTION

4.7.1 Urban Residential and Commercial Access Driveways and Carparks

All urban access driveways are to be designed in accordance with the requirements of *AS2890.1* for residential properties and *AS2890.2* for commercial premises and shall meet all requirements of standard drawings *EN7882* and *EN12046*. A compliance certificate shall be obtained from Council or an accredited certifier, certifying that the driveway has been constructed in accordance with the design levels, both prior to and after pouring the driveway.

Driveways shall be constructed in accordance with the requirements of standard drawings *EN7882* and *EN12046*. Materials others than those detailed in standard drawing *EN7882* will be considered on request; however, they shall provide a durable, hard-standing crossing which is not subject to erosion and does not hinder access to verge services or create a trip hazard. Where a driveway is dangerous or may interfere with stormwater runoff or pedestrian movements or the driveway has not been constructed to levels issued by Council, Council have the power to direct the property owner to rectify the driveway.

Due consideration shall be given to the position and floor level of building construction to ensure that vehicular access is possible. Driveways will be constructed to the property boundary across the verge 3m wide at 4% grade and adjustment of levels or widths within the verge to suit dwellings will only be permitted as detailed in *EN7882* and *EN12046*.

Commercial driveways will require consideration of axle loadings to determine the minimum required construction standard. Due consideration shall be given to the location of expansion and control joints.

Driveways across the verge from the kerb to the property boundary shall also consider the following additional requirements:

- Surface levels at the property boundary.
- Where kerb and gutter does not exist, the design/future gutter invert level.
- Clearance requirements for the critical design vehicle.
- Preventing ingress of road water into the property.
- Ensuring driveway does not obstruct major flows within the roadway.
- Consideration of traffic loading.
- Location of existing utilities and services.
- Sight distances shall be as required by *Austroads Guide to Road Design – Part 3: Geometric Design* and *TfNSW Supplement to Austroads Guide to Road Design – Part 3*.

There are currently two sets of specifications for driveways, detailed in *EN7882*:

- 2023 details and specifications which apply to:
  - All development applications submitted to Council after 21 September 2023.
  - In respect to development consents issued for residential developments prior to 21 September 2023 – where the land has an existing concrete footpath located across the frontage, Council will consider whether to apply the 2023 details and specifications on a case-by-case basis.
- Pre-September 2023 details and specifications which apply to:
  - All development applications submitted to Council prior to 21 September 2023. However, where the land has an existing concrete footpath located across the frontage, Council will consider whether to apply the 2023 details and specifications on a case-by-

case basis.

EN7882 and *EN12046* also detail when driveways are constructed (subdivision or dwelling stage) and the width requirements/allowances.

Driveway levels shall comply with the design (may be one of the standard designs or custom design approved/issued by Council) approved at access level application stage.

4.7.2 Rural Access Driveways

All rural access driveways shall be designed in accordance with the requirements of standard drawing *EN7881*.

Vehicular access locations shall be sited to consider the following factors:

- Existing natural surface levels at the property boundary.
- Sight distances shall be as required by *Austroads Guide to Road Design – Part 3: Geometric Design* and *TfNSW Supplement to Austroads Guide to Road Design – Part 3.*
- Clearance requirements for the critical design vehicle.
- Preventing ingress of road water into the property.
- Ensuring driveway does not obstruct major flows within the roadway.
- Consideration of traffic loading.
- Location of existing utilities and services.

The property gate or stock grid shall be installed with a setback of 10m from the boundary of the land with the public road. The minimum width of the crossing shall be 4m and shall be two coat bitumen sealed from the edge of the road wearing surface to the entrance gate or stock grid. The bitumen seal shall conform with one of the *TfNSW QA Roadworks Specifications* for sprayed bituminous surfacing. Pavement design shall be in accordance with *Clause 5* of this Section.

Rural driveways that will be used for significant commercial purposes, will be required to have the gateway setback 20m from the boundary of the land. The minimum width of the driveway shall be determined by taking into consideration the manoeuvring area required for a 19m semi-trailer.

4.7.3 Urban Battleaxe Lots

For urban battleaxe blocks, the full length of the access handle (including verge crossing) shall be paved in accordance with the requirements for urban residential driveways and standard drawing *EN7882*.

Keyed expansion joints shall be provided using 10mm thick bitumen impregnated filler boards at 12m maximum spacing, with sealed contraction control joints (e.g. 3mm wide, 40mm deep sawcuts) at no greater than 3m spacing.

Where such driveways will be used by commercial vehicles, the construction detail shall be increased to accommodate the additional requirements for urban commercial driveways.

4.7.4 Rural Battleaxe Lots

For rural battleaxe blocks, the full length of the access handle (including verge crossing) shall be provided with a minimum of 4m wide granular pavement with a minimum thickness of 150mm, sealed 3m wide with a two-coat bitumen seal. The bitumen seal shall conform with one of the *TfNSW QA Roadworks Specifications* for sprayed bituminous surfacing.

5. PAVEMENT DESIGN STANDARDS

5.1 GENERAL

This Clause provides guidance on the design of flexible pavements consisting of two or more layers of unbound granular or cemented materials, where the primary distress mode is load related. The pavement designer shall also consider the effects of environmentally induced stresses from moisture and temperature which may affect pavement performance.

In general, residential pavements shall be designed in accordance with the requirements of *Austroads Guide to Pavement Design – Parts 1 to 10* by a qualified designer in accordance with *Section 1 – General, Clause 5.2*.

5.2 SUBGRADE EVALUATION

A site investigation shall be performed which will include logging of test holes to a depth not less than one metre below design subgrade levels (unless rock is encountered). Soil tests shall be taken at the design depth and samples taken for CBR testing in accordance with *AS 1289*.

The design California Bearing Ratio (CBR) shall be selected following a careful assessment of the materials encountered in the site investigation, and the variability of subgrade moisture and density conditions likely in service. The design CBR value shall assume poor drainage and shall be determined from soaked CBR.

A copy of the site investigation, including test results, shall be included with the Engineering drawings.

Where the design subgrade CBR is below 3, the subgrade shall be chemically stabilised to a minimum depth of 150mm, and the pavement design based on a minimum CBR of 3.

5.3 PAVEMENT MATERIALS

Pavements shall be constructed from a minimum of two layers using either unbound granular, cemented, or a combination of these materials. Layers shall be a maximum of 200mm thick after compaction.

Unbound granular materials shall comply with *TfNSW QA Specification 3051: Granular Pavement Base and Subbase* Materials.

The type, grading, and strength of materials specified for use within the proposed pavement shall be shown on the typical cross sections submitted with the Engineering drawings.

5.4 DESIGN TRAFFIC

Pavements shall be designed using the number of Equivalent Standard Axles (ESA’s) shown in Table 6.1 of this Section.

Where circumstances dictate that a variation to these figures may be warranted, the Developer shall apply to Council for approval of the alternative. Such proposals shall be accompanied by careful estimates of the number of vehicles using the roadway by vehicle type, axle loading, and traffic growth over the life of the pavement. A minimum design life of 20 years for flexible pavements and 25 years for rigid pavements shall apply.

5.5 SUBSOIL DRAINAGE

Subsoil drainage pipes shall be installed on both sides of all new flexible road pavements (independent from and in addition to stormwater trench subsoil drainage), graded at a minimum longitudinal slope of 1% towards a suitable outlet, in accordance with standard drawings *EN7896* and *EN7897*. Where this slope is not achievable, guidance shall be obtained from

Council.

Subsoil pipes shall be in accordance with the requirements of *AS 2439* and consist of a 100mm diameter slotted corrugated Class SN8 PVC pipe enclosed in a geofabric sock, bedded in a well graded filter material in accordance with *Section 7 – Stormwater and Subsoil Drainage*.

Flushout points shall be installed at the upstream end of the pipe, and at regular intervals a maximum distance of 100 metres apart.

5.6 DESIGN OF FLEXIBLE PAVEMENT

Pavement thickness design shall be based on the assessed subgrade strength, in accordance with *Austroads Guide to Pavement Design – Parts 1 to 10*.

Road shoulders shall be constructed using the full depth of pavement required for the adjacent traffic lanes. Note that the minimum depth of pavement shall be 250mm.

5.7 PAVEMENT SURFACING

New urban residential, commercial, and industrial roads shall be surfaced with a minimum 40mm thickness of Asphaltic Concrete (AC) laid upon a sprayed bituminous prime coat, designed in accordance with *Austroads Guide to Pavement Design – Part 4K – Seals* and conform with one of the *Transport for NSW (TFNSW) QA Roadworks Specifications* for asphalt surfacing. Layers of asphaltic concrete may be included in the total design pavement depth but shall not be assigned a layer equivalency of greater than unity.

Where residential development fronts an existing sealed pavement in sound condition, a sprayed seal may be appropriate. See *Clause 4.4.8* of this Section for further details.

Roundabouts shall be constructed using Grade 320, full-depth asphalt.

Rural and Rural Residential roads shall be surfaced with a two-coat sprayed seal over a prime seal with adequate curing time.

Alternative surface treatments may be submitted to the Director of Engineering Services for approval, provided the surfacing is compliant with Austroads and TfNSW standards and exhibits the following characteristics:

- Impermeable to air and moisture.
- A long service life and is maintenance free for a considerable period.
- Flexible.
- Acceptably low longitudinal roughness.
- Adequate low speed skid resistance.

5.8 SERVICE CROSSINGS

Where possible, all underground conduits, services and utilities shall be placed under the road prior to construction of the initial pavement course, and their location marked on the kerb and gutter. Trenches shall be constructed at a minimum grade of 1% to permit drainage of sub-surface water.

Road crossings through existing pavements will require backfill using a 27:1 sand:cement mix in accordance with standard drawings *EN7892, EN7901* and *EN7904*.

6. BRIDGE AND CULVERT DESIGN

Bridges and culverts shall be designed in accordance with *Section 3 – General Design*

Standards & Requirements.

Culvert headwalls shall be constructed as a sloped headwall within Council's road reserve when:

- The culvert is constructed outside of ± 40° from perpendicular with the main road centreline.
- Any part of the headwall is less than 4m from the road edge of formation.
- When Council determines that there is a risk of an errant vehicle colliding with the headwall at an undesirable angle.

Council will consider removing the requirement for a sloped headwall where an approved safety barrier system in accordance with TfNSW and Austroads standards is provided to prevent errant vehicles colliding the headwall.

7. ROAD FURNITURE DESIGN

Road furniture shall be designed to minimise the number of roadside obstructions, maintain sight distance and ensure that the risk of injury to vehicle occupants and pedestrians is minimal.

7.1 STREET SIGNS

Street signs are required at all road junctions. Signs may either be purchased from Council or manufactured and installed in accordance with standard drawing *EN7880*. Roundabout signage shall comply with standard drawing *EN10775*.

The location of street signs shall be shown on the Engineering drawings.

7.2 TRAFFIC CONTROL DEVICES

Traffic control devices shall be erected as required by the requirements of *Section 1 – General, Clause 16*.

The consent of Council's Traffic Committee will be required prior to the installation of any traffic control devices on existing roads.

7.3 LOCAL AREA TRAFFIC MANAGEMENT

Where conditions of a development consent so indicate, Local Area Traffic Management (LATM) devices shall be designed and installed to the requirements of *Section 1 – General, Clause 16*.

7.4 PUBLIC TRANSPORT

Roads used as public transport routes may require the provision of facilities such as bus shelters, bays, and low kerbing. Intersections, roundabouts, and median storage lanes on these routes shall be designed to cater for the maximum dimension single unit truck/bus, without requiring reversing manoeuvres.

When placing road furniture, consideration shall be given to the swept path of overhanging bodywork and the location of passenger waiting areas.

Bus stops and shelters shall always be located on the departure side of footpath, cycleways and shared paths. The need to locally widen verges to provide visibility from adjacent driveways and intersections shall be assessed.

7.5 ROAD LIGHTING

In accordance with the Development Control Plan, the Developer is required to provide appropriate street lighting for the whole of the Development and shall comply with:

- *AS 1158 – Lighting for roads and public spaces*

- *AS 60598 - Luminaires*
- Relevant Supply Authority standards and requirements

Notwithstanding these requirements, lighting shall be provided at all intersections, at the end of all cul-de-sacs and to all concrete paths. Lighting columns shall generally be located on the verge alignment shown in standard drawings *EN7885 and EN12046*. Slip-base lighting columns shall be used where the light column will be located near the carriageway. Energy absorbing columns may be required where fallen columns would be particularly hazardous.

7.6 PUBLIC GATES AND GRIDS

7.6.1 Conditions

The permit holder is responsible under the *Roads Act NSW 1993* for the maintenance of the Grid and Gate, the bypass road to the gate and 20m of road on the approach to a grid.

Gates on unmaintained Council Road reserves will remain the maintenance responsibility of the permit holder.

Use of electrified grids is NOT permitted.

In the event of the ownership of the subject property being transferred, the permit holder shall produce the existing permit to the Council, together with an application to assign, in the form applicable at the time of the assignment. Council maintains the right to refuse its consent to the assignment.

7.6.2 Approval

If permission is to be granted for the erection of gate/grid, an advertisement shall be placed in the local newspaper inviting interested persons to lodge objections in writing, allowing 28 days for this to occur. Notice shall also be given to the adjacent owner/s. If objections are received a report shall be prepared for submission to Council for determination.

Applications will only be considered if the road is fenced on one side only, or the road is not fenced at all and only where roads are not classed as Collector roads or above. For other roads with an average daily traffic volume greater than 20 (ADT>20), only double grids will be permitted, whilst where the volume is less than 20 (ADT<20), a single grid may be accepted.

Grids and gates shall only be erected at locations approved by Council and as directed by the General Manager.

7.6.3 Construction

Prior to commencement, approval must be obtained in writing from the General Manager. Then at least 14 days' notice shall be given to the General Manager prior to commencement of any work – the exact position of the grid and gate as agreed by Council must be pegged on site.

The Developer shall fully indemnify Council in relation to the works required in this licence and to all damage to other services including water, electricity supply and communication services. All work is to be undertaken at the owners' expense and risk.

The centre of the grid or gate shall coincide with the centreline of the road. Gates shall be constructed at a right angle to the road centreline.

Approach ramps shall be constructed for the full width of the running surface of the grid. The longitudinal grade of the approach ramps shall be such that the surface levels of the ramps deviate from the existing average grade of the road by not more than 1%. The fill used in the

approach ramps shall be thoroughly compacted and finished to the satisfaction of the General Manager.

The owner shall construct and seal approaches 20m each side of the gate and grid and must be fully reinstated and compacted.

The approach surface is to start flush with the grid. At 20m from the grid, the road surface is to grade away from the centreline of the road at a 3% cross fall. Alternatively, Council may require a one-way cross fall of 3%.

Any repair/compaction required to be undertaken by Council will be charged for as Private Works.

A fully compacted 3.6m wide bypass road will also need to be constructed around each grid, through the adjacent gate.

The Developer shall construct drainage under the grid and adjacent gated bypass road, to ensure that no ponding occurs on the roadway.

Cattle grids shall be capable of carrying a SM1600 loading with a safety factor. These are available through several manufacturers. In certain circumstances it may be necessary to provide design details for the structure to cater for SM1600 and be certified by a structural engineer. Several companies manufacture prefabricated cattle grid units. Details of the proposed grid and the installation layout shall be submitted to Council for approval with the application.

Signs must be erected for any new ramp/grid installed on roads in this Council area which are less than 4.8m in width. Signs shall be in accordance with *AS 1742*.

Sufficient guideposts and rails shall be provided to satisfy road traffic safety requirements at the specific location.

Gates shall be a minimum of 3.6m wide and be fully functional to enable unimpeded access and shall be white in colour.

7.6.4 Maintenance and Repairs

Where the grid/gate is on a maintained Council Road and has been constructed to Council's standards and approved for use by Council, the Developer shall be fully responsible for all maintenance and repair of the grid/gate, sign posting, and the road approached either side of the grid/gate.

Where an existing grid/gate is not being maintained to the appropriate standard, Council will serve a notice on the occupier/owner to carry out remedial works within 7 days. Failure to comply with the notice will result in the levying of penalties as contained in the *Roads Act 1993*, or cancellation of the permit; The Director of Engineering Services may cancel the permit for failure to carry out remedial work or when changes occur to the classification or alignment of the road.

The owner occupier shall be responsible for all removal and road reinstatement costs; the permission for any existing gates or cattle grids erected prior to the adoption of this policy shall be revised, and the owner or occupier will be requested to comply with the current policy where deemed reasonable; where the owner or occupier wished to transfer permission for the grid or gate, they shall apply to Council and be subject to the approval from the General Manager.

7.6.5 Renewal and Removal

Council may at any time revoke this licence or alter the above conditions. Where an application is received for the removal of a gate/s and replacement by a grid the same conditions shall apply.

7.6.6 Technical Standards

- Position, design and materials shall be approved by Council, the position to be adequately drained and minimum size of pipes to be 450mm.
- No installation is permitted on bitumen, and major gravel roads (ADT>200).
- Specification of grid installation:
  - Clear width: 3.6m single lane road OR 7.2m double lane road minimum.
  - Length: 1.8m minimum.
  - Bar Spacing: 0.2m.
  - Approach Slab: 2m x width x 0.15m reinforced including protection angle at each end.
  - Strength: SM1600 with a factor of safety.
  - Skew Offsets of 180mm and 360mm respectively to ensure offside wheels of traversing vehicles make initial contact.
- Unlocked gates – minimum width of 3.6m shall be provided at all installations.
- Gates, Bypasses and Signage shall comply with the requirements of Section 128 to 137 inclusive of the *Roads Act 1993*.

8. ROAD LANDSCAPING DESIGN

Landscaping within the road reserve may be used for aesthetic reasons, or functional purposes such as screening headlight and sunlight glare, screening undesirable views, and providing visual guidance.

Plantings within the road reserve shall be designed so as not to obstruct sight distances. Care shall be taken with planting around curves, near intersections and driveways, and on pedestrian travel routes.

Only species approved by Council shall be planted.

Approved slopes steeper than 1:6 will not be mown, and consequently maintenance free finishes approved by Councils engineer shall be specified if steep slopes are required in urban areas.

See *Section 4 – Site Restoration & Landscaping* and *Section 11 – Open Space Areas* for additional requirements and specifications regarding landscaping.

8.1 ROUNDABOUT LANDSCAPING

Landscaping/vegetation requirements for roundabouts are as follows:

- Vegetation requirements will vary for each roundabout. The Developer shall provide proposed planting and irrigation details to Council's recreation section for approval for each individual roundabout. In all cases, approved garden soil shall be provided to a minimum of 600 deep and covered with a layer of approved mulch.
- Vegetation is to be permitted within the envelopes as per standard drawing *EN10775* or as approved by Council's engineer.
- Vegetation that grows outside these envelopes shall be trimmed or removed to comply

with envelopes or as approved by Council's engineer.

- Signage shall also be installed with vegetation to all roundabouts as per standard drawing *EN10775* and shall be a maximum height of 1.1m.

9. FLEXIBLE PAVEMENT CONSTRUCTION

9.1 MATERIALS

All unbound pavement construction materials shall comply with the requirements of *TfNSW QA Specification 3051: Granular Pavement base and Subbase Materials (TfNSW 3051)* as below:

- Base courses shall be constructed from 'DGB20' as defined by the specification *TfNSW 3051.*
- Subbase courses shall be constructed from 'DGB', 'DGS' or 'MB' as defined by the specification *TfNSW 3051*.

9.2 GENERAL REQUIREMENTS

9.2.1 Course Thickness

Unless otherwise specified or directed, base and subbase courses shall have a final compacted thickness as specified in the approved drawings and specification. Materials shall be of the best quality available and in accordance with *TFNSW 3051* and to the satisfaction of Council's engineer.

Each layer shall be placed such that:

- No single layer shall have a compacted thickness of more than 200mm per lift.
- No single layer shall have a compacted thickness of less than 75mm per lift.

Surface shape shall be such that water cannot accumulate at any point. Where pavement abuts a gutter, the surface level at the edge shall be within 10mm of the actual concrete level, or as is necessary to accommodate the specified thickness of surfacing.

9.2.2 Trimming and Compaction

Pavement material shall not be placed on the subgrade or previous layers of pavement until those layers have been approved. Material shall not be placed over a layer weakened by moisture.

Granular materials, when delivered, shall have a moisture content within ± 2% of the modified optimum moisture content.

Spread material in uniform layers as near as practicable to the required thickness by direct tipping from suitable vehicles or using a mechanical spreader. Take care to avoid segregation of material during tipping and spreading. The tipping of material in heaps and spreading by grader shall be minimised. If material becomes segregated, it shall be remixed as directed using a rotary hoe or other suitable equipment.

During compaction, maintain moisture content of pavement materials within ± 2% of the optimum moisture content. Water spraying equipment used for this purpose shall be capable of uniformly distributing water in controlled quantities over uniform lane widths.

After the mixture has been brought to the specified moisture content, it shall be compacted immediately. The compaction shall begin at the sides and progress to the centre, parallel with the centre line of the roadway, uniformly lapping each preceding pass and covering the surface completely.

Base and subbase layers shall achieve 100% standard maximum dry density when tested in accordance with *AS 1289*.

After compaction, the subgrade profile shall be prepared parallel to the finished surface at the specified depth below the detailed cross sectional and grade lines and over the required widths. The subgrade profile may be tested at the discretion of Council's engineer by means of a survey equipment or a straight edge template to check its accuracy.

10. BITUMINOUS PAVEMENT CONSTRUCTION

10.1 MATERIALS

Bituminous pavement materials used for construction shall fully comply with all material requirements of the relevant *TfNSW QA Roadworks Specifications* listed in *Clause 2* of this Section.

10.2 PLACEMENT

Bituminous pavement construction workmanship shall fully comply with all plant, placement and workmanship requirements of the relevant *TfNSW QA Roadworks Specifications* listed in *Clause 2* of this Section.

10.3 FINISHED PAVEMENT PROPERTIES

Finished bituminous pavement properties shall fully comply with requirements of the relevant *TfNSW QA Roadworks* Specifications listed in *Clause 2* of this Section.

10.3.1 Sprayed Bituminous Surfacing

In addition to the requirements of the relevant *TfNSW QA Roadworks* specification, sprayed bituminous surfacing finish aspects shall be to the satisfaction of Council's engineer and comply with, but not be limited to, the following aspects:

- Even aggregate and binder application to all sealed areas.
- Binder and aggregate adhesion to below surface.
- No cracking or exposed pavement areas.
- Consistent surface shape and crossfalls.

10.3.2 Asphalt

Asphalt finish aspects that shall comply with the relevant *TfNSW QA Roadworks Specification* include, but are not limited to:

- Insitu air voids.
- Course thickness.
- Course position.
- Surface shape.
- Ride quality.

10.4 CONFORMITY

10.4.1 Sprayed Bituminous Surfacing

All sprayed sealed bituminous surfacing shall be homogenous in appearance. Areas of surfacing which exhibit inadequate or inconsistent binder and aggregate application, poor binder adhesion to the below surface, cracking, or have been damaged by construction will be replaced by the Developer.

10.4.2 Asphalt

All asphalt shall be homogenous in appearance. Areas of asphalt which exhibit segregation, cracking, ravelling, bony or fatty material or have been damaged by construction will be removed and replaced by the Developer.

11. TESTING, PRODUCTION/PLACEMENT RECORDS & SURVEY REQUIREMENTS

Where testing and survey items are specified by Consent Conditions or Council's engineer, the Developer shall arrange for the testing to be undertaken. Testing shall be treated as a hold point in the development and subsequent works shall not proceed until approval has been given.

Where specified, tests shall be undertaken in accordance with Australian Standards by a NATA approved testing laboratory. All test results from the NATA approved testing laboratory shall be filed and provided to Council, regardless of the results of the testing.

11.1 MATERIALS

All materials shall be proven to be compliant with the requirements of this Section by provision of material specifications and/or NATA laboratory testing.

All flexible pavement materials shall be proven to be compliant with the requirements of the *TfNSW 3051* Specification by a NATA approved testing laboratory.

All bituminous pavement materials shall be proven to be compliant with the requirements of the relevant *TfNSW QA Roadworks Specification* by a NATA approved testing laboratory.

11.2 TESTS, PRODUCTION/PLACEMENT RECORDS & SURVEY

- Flexible pavement nominated material tests to show full compliance with *TfNSW 3051* by NATA laboratory.
- All subgrade/flexible pavement courses standard maximum dry density (SMDD) and California Bearing Ratio (CBR) testing by NATA laboratory.
- Asphalt nominated mix testing to show full compliance with the relevant *TfNSW QA Roadworks Specification* by NATA laboratory.
- Asphalt production mix particle size distribution and binder content testing by NATA laboratory.
- Asphalt base and wearing courses insitu air voids testing by NATA laboratory. ***Note:*** *Ensure that production mix sample is provided to testing company to allow asphalt density bias to be determined – will prevent the need to core finished surface at density testing stage.*
- Sprayed bituminous surfacing production mix certified records stating compliance with the relevant *TfNSW QA Roadworks Specification*.
- Sprayed bituminous surfacing certified binder spray rates records.
- Sprayed bituminous surfacing certified aggregate application rate records.
- Level survey by registered surveyor and straightness and finished properties inspection with Council's Engineer.

11.3 TESTING, PRODUCTION/PLACEMENT RECORDS & SURVEY SPECIFICATION

All items listed in *Clause 11.2* of this Section shall comply with the requirements of this Clause. Tables 6.4 to 6.11 describe the required test types, results, tolerances and frequencies of testing.

TABLE 6.4 – Required Tests, Production/Placement Records and Survey Description

Item	Required Tests, Production/Placement Records and Survey Description
Flexible pavement materials	• All tests defined in *TfNSW 3051*.

Prepared subgrade/flexible pavement courses	• Deflection testing - Proof roll with either:
	  o A roller with a load intensity of 7 tonnes per metre width of roller.
	  o A tandem axle rigid vehicle, having a maximum load of 15 tonne per axle group (8 tyres), 12 tonnes per axle group (6 tyres), or 10 tonnes per axle group (4 tyres). Single axle vehicles shall have maximum loads of 8.5 tonnes (dual tyres), or 5.4 tonnes (single tyres).
	• SMDD compaction test to *AS 1289.*
	• CBR test to *AS 1289*.

Bituminous nominated mixes	• All individual material tests defined in the relevant *TfNSW QA Roadworks Specification*.
Asphalt production mix	• Particle size distribution test as defined in the relevant *TfNSW QA Roadworks Specification*. • Binder content test as defined in the relevant *TfNSW QA Roadworks Specification*.
Asphalt subbase courses	• Deflection testing as described above.
Asphalt base and wearing courses	• Insitu air voids testing to *AS 2891*. **Note:** Ensure that production mix sample is provided to testing company to allow asphalt density bias to be determined – will prevent the need to core finished surface at density testing stage.
Sprayed bituminous surfacing production mix	• Developer to submit certified records fully detailing the production mix and stating compliance with the relevant *TfNSW QA Roadworks Specification*.
Sprayed bituminous surfacing application rates	• Developer to submit certified records of all binder spray rates to check compliance with nominated mix rate. • Developer to submit certified records of aggregate application rates to check compliance with nominated mix rate.
Level and straightness and finished properties compliance	• Survey undertaken by registered surveyor at subgrade course. • Survey undertaken by registered surveyor on wearing course (works as executed survey will be acceptable). • Thickness may be checked by Council's Engineer at any time. • Inspection of straightness with Council's Engineer. • Inspection of finish homogeneity with Council's Engineer.

TABLE 6.5 – Required Results

Item	Required Results
Flexible pavement materials (2)	• All properties defined in the specification *TfNSW 3051*.
Prepared subgrade/flexible pavement courses (1)	• No movement of the pavement layer during deflection testing proof roll. • SMDD shall be 98% at ± 2% optimum moisture content for subgrade and 100% at ± 2% optimum moisture content for flexible pavement base. • CBR shall comply with pavement design.
Bituminous nominated mixes (2)	• All properties defined in the relevant *TfNSW QA Roadworks Specification*.
Asphalt production mix (3)	• Particle size distribution shall target approved nominated mix. • Binder content shall target approved nominated mix.
Asphalt subbase courses (1)	• No movement of the pavement layer during deflection testing proof roll.
Asphalt base and wearing courses (4)	• No movement of the pavement layer during deflection testing proof roll. • Insitu air voids shall not be outside the specified limit Vu approved in the nominated mix design.
Sprayed bituminous surfacing production mix (5)	• All materials and proportions used in production mix shall comply with the approved nominated mix and comply with the requirements of the relevant *TfNSW QA Roadworks Specification*.
Sprayed bituminous surfacing application rates (6)	• Binder spray rates shall target approved nominated mix. • Aggregate application rates shall target approved nominated mix.
Level and straightness and finished properties compliance (7)	• Levels shall target design. • Thickness shall be within tolerance. • Straightness shall be uniform. • Finished properties shall be homogenous.

(1) – failure to achieve any of the required results means non-compliance for that course and any subsequent courses.

(2) – if any individual material fails to meet required results, the material is not to be used without written approval of the Council's Engineer.

(3) – see Table 6.6 for tolerances.

(4) – failure to achieve deflection testing results means non-compliance for that course and any subsequent course. See Table 6.7 for insitu air voids tolerances.

(5) – failure to use materials defined in the approved nominated mix or failure to comply with the relevant *TfNSW QA Roadworks Specification* means non-compliance for the surfacing.

(6) – see Tables 6.8 and 6.9 for tolerances and penalties.

(7) – see Table 6.10 for tolerances.

TABLE 6.6 – Asphalt Production Mix Tolerances

Combined Particle Size Distribution Element	Tolerance - % by which mass of total aggregate passing may vary from approved nominated mix
Pass 37.5mm AS sieve	Maximum of 7%
Pass 26.5mm AS sieve	Maximum of 7%
Pass 19.0mm AS sieve	Maximum of 7%
Pass 13.2mm AS sieve	Maximum of 7%
Pass 9.50mm AS sieve	Maximum of 7%
Pass 6.70mm AS sieve	Maximum of 7%
Pass 4.75mm AS sieve	Maximum of 7%
Pass 2.36mm AS sieve	Maximum of 5%
Pass 1.18mm AS sieve	Maximum of 5%
Pass 0.600mm AS sieve	Maximum of 4%
Pass 0.300mm AS sieve	Maximum of 4%
Pass 0.150mm AS sieve	Maximum of 2.5%
Pass 0.075mm AS sieve	Maximum of 1.5%
Binder Content for	**Tolerance - % by which % of mass of binder in asphalt may vary from approved nominated mix**
20mm asphalt or smaller	Maximum of 0.3%
28mm and 40mm asphalt	Maximum of 0.3%

TABLE 6.7 – Asphalt Insitu Air Voids Tolerances

Insitu Air Voids	Tolerance - % by which test sample may be below approved specified limit Vu
Average of all samples	Maximum of 2.0%
Any one sample	Maximum of 3.0%

TABLE 6.8 – Sprayed Bituminous Surfacing Binder Application Rates Tolerances and Penalties

Difference from approved nominated binder spray rate	Penalty
Less than 95% of approved rate	Second spray run as directed by Council's Engineer or non-compliance
More than 110% of approved rate	Surface covered with sand as directed by Council's Engineer or non-compliance

TABLE 6.9 – Sprayed Bituminous Surfacing Aggregate Application Rates Tolerances and Penalties

Difference from approved nominated aggregate application rate	Penalty
Less than 95% of approved rate or insufficient coverage in the opinion of Council's Engineer	Aggregate to be re-run by the mechanical spreader to give a uniform and complete coverage as directed by Council's Engineer or non-compliance
More than 110% of approved rate of excessive aggregate in the opinion of Council's Engineer	Excess aggregate to be to be scattered and evenly distributed or stockpiled as directed by Council's Engineer or non-compliance

TABLE 6.10 – Pavement Level, Thickness, Straightness and Finished Properties Tolerances

Layer	Item	Tolerance
Base and Wearing Courses	Level	No more than 50% of all survey points to be outside of ± 20mm of design
		No more than 10% of survey points to be outside of ± 50mm of design
	Thickness	AC 5 = - 0mm to + 5mm AC 7 = - 0mm to + 5mm AC 10 = - 0mm to + 6mm AC 14 = - 0mm to + 8mm AC 20 = - 0mm to + 10mm AC 28 = - 0mm to + 12mm
		Flexible Courses = ± 10mm
	Straightness	10mm maximum departure from a 3m straight edge in any direction
	Finished properties	Must be homogenous in appearance, no cracking
Subbase Courses	Level	As per base and wearing course
	Thickness	As per base and wearing course
	Straightness	20mm maximum departure from a 3m straight edge in any direction
	Finished properties	Must be homogenous in appearance, no cracking
Subgrade Course	Level	All survey points must be equal to or lower than design
	Straightness	20mm maximum departure from a 3m straight edge in any direction

TABLE 6.11 – Required Test Frequencies for NATA Laboratory Works

Item	Required Frequency
Flexible pavement materials	• Proof of material compliance prior to ordering. • One test every 500m^3 of imported material for each material type.
Prepared subgrade/flexible pavement base	• SMDD and CBR tests shall be undertaken for each layer at the following frequencies: o Roads – whichever is the greatest of three tests over the foundation area or one test every 50m of road. o Carparks/open areas – whichever is the greatest of three tests over the foundation area or one test every 500m^2.
Nominated mix materials	• One test for each individual material.
Asphalt production mix	• A minimum of one test at the start of each day and one test every 500 tonne of material produced on that day thereafter.
Asphalt base and wearing courses	• Insitu air void testing shall be undertaken at whichever is the greatest of three tests over the pavement area or one test every 500m^2.

SECTION 7 – STORMWATER & SUBSOIL DRAINAGE

1. INTRODUCTION

This Section of the Guidelines for Engineering Works outlines Council's requirements for design and construction of drainage.

Developers of land shall be wholly responsible for disposing of all stormwater runoff which passes over or through the respective properties, roads and reserves.

2. STANDARDS & REFERENCES

Unless otherwise specified or approved, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standards listed in this Section.

Standards include, but are not limited to:

- *AS 1141 – Methods for sampling and testing aggregates*
- *AS 1214 – Hot-dip galvanised coatings on threaded fasteners*
- *AS 1254 – PVC-U pipe and fittings for stormwater and surface water applications*
- *AS 1260 – PVC-U pipes and fittings for drain, waste and vent applications*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 1316 – Masonry cement*
- *AS 1597 – Precast reinforced concrete box culverts*
- *AS 2032 – Installation of PVC pipe systems*
- *AS 2033 – Installation of polyethylene pipe systems*
- *AS 2439 – Perforated plastics drainage and effluent pipe and fittings*
- *AS 2566 – Buried flexible pipelines*
- *AS 2648 – Underground marking tape*
- *AS 3500 – Plumbing and drainage*
- *AS 3725 – Design for installation of buried pipes*
- *AS 3850 – Prefabricated concrete elements*
- *AS 3996 – Access covers and grates*
- *AS 4058 – Precast concrete pipes (pressure and non-pressure)*
- *AS 4680 – Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
- *AS 5065 – Polyethylene and propylene pipes and fittings for drainage and sewerage applications*
- *Australian Rainfall and Runoff: A Guide to Flood Estimation*
- *Austroads Guide to Road Design – Parts 5 and 5A - Drainage*
- *Managing Urban Stormwater: Soils and Construction – Volume 1 (NSW Blue Book)*
- *Concrete Pipe Associate of Australia (CPAA) – PipeClass Software*

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN7883 – Trench Shielding Requirements*
- *EN7885 – Urban Road Verge Allocation Detail Pre-September 2023*

- *EN7886 – Kerb Inlet Pit Details*
- *EN7887 – Junction Pit Details*
- *EN7888 – Surface Inlet/Surcharge Pit Details*
- *EN7889 – Interallotment Pit Details*
- *EN7890 – Penstock Pit Details*
- *EN7891 – Interallotment Pit in Concrete Path Details*
- *EN7892 – Stormwater Pipe Bedding & Backfill Details*
- *EN7893 – Kerb Inlet Pit Deflector Design*
- *EN7894 – Building Stormwater Footpath/Verge Conversion Details*
- *EN7895 – Pipe Restraint & Concrete Bulkhead Details*
- *EN7896 – Subsoil Drainage Details*
- *EN7897 – Subsoil Drain Flushout Point and Outlet Details*
- *EN7902 – Zone of Influence Diagram and Pipe Concrete Encasement Details*
- *EN9161 – Floodway within Footpath Details*
- *EN12046 – Urban Road Typical Layout & Verge Details in Greenfield Sites from 21 September 2023*

3. ENGINEERING DRAWINGS

Engineering drawing submissions shall include all information requested in *Section 1 – General, Clause 5*.

3.1 PLANS

Drainage plans shall be drawn at a standard scale not greater than 1:500 sufficient to show all necessary details. The following information shall be included with a contoured catchment area plan:

- Catchment areas and sub-areas, watershed (catchment boundary), overland flow paths, existing and proposed pipe layout. For large catchments, the total catchment area shall be shown at a large scale on a separate plan or inset. All sub-areas, drainage lines and pits shall be logically numbered.
- A schedule of pipe details, including pipe number, size, class, bedding type, joint type, invert levels at inlet and outlet, slope and length.
- A schedule of pit details, including pit number, type, road chainage, surface level, invert level, depth and lintel length.
- North point and legend.
- Setout information.
- Accurate position and level of all services and utilities which cross underground drainage pipelines.
- Identify those building allotments adjacent to channels and major storm flow paths which may be liable to flooding in major flood events, and the minimum design habitable floor level adjacent to prevent flooding in the design flood event.
- Inlet and outlet treatments.

3.2 LONGITUDINAL SECTIONS

Longitudinal sections shall be drawn at a scale to show all necessary details, nominally at a

standard scale not exceeding 1:500 with a vertical exaggeration of 2 or 5, for all road drainage, interallotment drainage, and open channels. The following details shall be included:

- Road chainage (where applicable), cumulative pipe distance, design surface level and design pipe invert level - all marked beneath the longitudinal pipe section. Longitudinal sections for channels and floodways shall be provided in a similar format to road longitudinal sections.
- Pit number, design pit inflow, pit type, pipe size, pipe class, trench installation, pipe velocity and design pipe discharge.
- Hydraulic grade line.

3.3 CROSS SECTIONS

Cross sections shall be provided at all culverts, and for open channels at maximum 20m spacings.

Culvert details shall include all items required for longitudinal sections, and whether the inlet or outlet is the factor governing flow capacity.

Channel and floodway cross sections shall include details of hydraulic grade levels and available freeboard.

3.4 SUPPORTING INFORMATION

All stormwater drainage design submissions shall include drainage calculations and a certification from the designer. The design must be undertaken by a qualified designer in accordance with *Section 1 – General, Clause 5.2*.

3.4.1 Drainage Calculations

Hydrologic and hydraulic calculations shall be submitted with the design plans and based on a fully developed catchment. Details shall include:

- Flow lengths, slopes and travel times, for overland and gutter flows.
- Full and partial area calculations.
- The adopted return frequencies, runoff coefficients, and rainfall intensities.
- Pit inlet capacities.
- Pipe lengths, full-pipe flow velocities, hydraulic grade line and pipe slopes.
- Pit pressure change coefficients.
- Pit and pipe invert and surface levels.
- Velocity times depth relationship for all overland flow paths.
- Design discharges.
- A copy of the 1% (major) and 20% (minor) AEP stormwater models. It is accepted that data/software file types will vary depending on the software package used by the designer. The file will become intellectual property of Bathurst Regional Council.

3.4.2 Software Design Packages

Where commercially available software packages are used to design stormwater systems, a copy of all data files shall be provided to the Council prior to approval being granted. Note that the use of software does not negate the designer of his responsibility in ensuring an appropriate design which meets the requirement of these Guidelines. The Developer will still need to submit details as per *Clause 3.4.1* of this Section above.

3.4.3 Certification

The designer shall provide a statement to accompany the design plans, certifying that:

- All requirements contained within these Guidelines have been met and any proposed deviations from these Guidelines have been documented in full.
- Open spaces and roadways are adequate to safely contain all flows from the design 1% Annual Exceedance Probability (AEP) flood event and further, that the maximum velocity, maximum depth, and the product of velocity and depth, are all within prescribed limits.
- That 500mm freeboard has been provided in the 1% AEP event with respect to building floor levels and all ground surface levels on each allotment within the development.

4. GENERAL DESIGN REQUIREMENTS

Stormwater drainage systems in new areas of Bathurst shall be designed using a major/minor approach.

The minor drainage system consists of underground pipes designed to control nuisance flooding, while the major system consists of an overland flow path or floodway to accommodate less frequent flood events.

Pipe capacities shall be calculated for pipes flowing full under gravity conditions. The design flood frequency shall be the 1% AEP event.

Where the drainage catchment includes an existing pipe system of unknown or limited capacity, the Developer shall either:

- Replace or augment the existing pipe system.
- Modify the existing system, by acquiring land, if necessary, to provide a safe major flow route.
- Hydraulically improve the existing system to reduce energy losses.
- Limit the flows from new developments to keep downstream flows within the capacity of the system.

Major system drainage designs shall aim at controlling flood flows so that the severity of flooding downstream, and afflux upstream, is not increased. In all designs, consideration must be given to the effect of floods greater than the design flood, and in no circumstances shall the design create conditions where the capacity of the downstream drainage system is exceeded.

The design flood shall be accommodated using pipe drainage, drainage channels, overland flow paths, floodway's, etc, as necessary, to accommodate the safe passage of floods if the minor system is blocked.

Stormwater flows up to the design flood frequency shall be carried in a system of channels and/or pipes within the Development. No uncontrolled overland flow will be permitted for return periods less than the design flood.

Where stormwater discharge is concentrated onto other property, and/or works are necessary on the other property, it is the responsibility of the Developer to make appropriate arrangements and provide Council with a copy of the owner's consent, prior to the release of a construction certificate for the works. This may necessitate the creation of an easement to drain water through downstream properties, and all costs and compensations shall be borne by the Developer.

4.1 DESIGN ANNUAL EXCEEDANCE PROBABILITIES

AEPs for design purposes are shown in Table 7.1 below:

Table 7.1 – Design Annual Exceedance Probabilities

Land Use	Annual Exceedance Probability (AEP)
Road Drainage - Minor (Piped) System	
Arterial Roads (Cross Drainage)	2%
Rural & Rural Residential Roads (Cross Drainage)	20%
Urban Roads	20%
Sag Point (must have a defined 1% AEP overflow route)	20%
Commercial	20%
Floodway 'low flow' system	100%
Interallotment Drainage	20%
Trunk Drainage	1%

The major system drainage shall be designed to cater for flows from the 1% AEP storm event, with freeboard, on the assumption that the minor system is totally blocked. Continuous designated overland flow paths shall be provided from the top of the catchment through the entire Developed area.

The designer shall consider special damage or danger to life and property which may occur in specific situations. In such cases, the design frequency of flooding recommended or adopted shall be the subject of specific advice and reports to Council for determination. In no circumstances shall the design flood be less than the 1% AEP flood event.

4.2 DESIGN RAINFALL INTENSITIES FOR BATHURST

Design rainfall intensities for the Bathurst Regional Council Local Government Area shall be obtained from the online ARR Data Hub based on the design storm duration and annual exceedance probability. The data used shall be the most recently published.

4.3 MINIMUM FLOOR AND ALLOTMENT LEVELS

All developable land and structures shall be located a minimum 500mm above the maximum water level in the 1% AEP flood event.

For new subdivisions, the Developer shall ensure that the lowest point in all allotments is located a minimum 500mm above the 1% AEP flood level. Further, the Developer shall note the minimum allowable floor level on the WAE plans for all lots adjoining overland flow paths.

4.4 ROAD DRAINAGE

The function of road drainage is to capture surface runoff from the design storm event, and safely convey it to an approved reserve or receiving waters with minimal damage, danger and nuisance to life, property and the environment.

4.4.1 Drainage Pits & Headwalls

4.4.1.1 General Requirements

- Pits shall be provided in drainage lines at all changes in grade, level, and direction, and at all pipe junctions and shall be spaced at no more than 85m apart.

- Drainage pits shall conform to Council's standard drawings, or to *TfNSW* standards for Classified Roads. Non-standard structures shall be constructed as detailed in the design drawings. Such designs shall comply with the requirements of *Section 3 – General Design Standards and Requirements*.
- Pits used for stormwater drainage shall be fitted with square lids to distinguish them from sewer manholes.
- Junction pits shall be fitted with reinforced lids and approved lifting eyes.
- Interallotment pits shall not be used for street or roadway drainage.
- Kerb inlet pits shall be constructed using precast one-piece kerb units where practicable. One-piece units shall have bike safe grates.
- Precast pits shall include bases. Where insitu bases are proposed, approval from Councils engineer is required.
- Pit base level shall match outlet pipe invert.
- Minimum internal pit dimensions 600m x 600mm generally.
- Pits deeper than 1m to have minimum internal dimensions of 900mm x 900mm for access.
- Pits deeper than 1.2m to have step irons for safe access.
- Every endeavor shall be made to maintain flow velocities through pits. Excessive drops will not be permitted.
- Headwalls shall include concrete bases and/or energy dissipator devices to the requirements of the *NSW Blue Book*.
- Headwalls shall be constructed as a sloped headwall within Council's Road reserve when:
  - The culvert is constructed outside of ± 40° from perpendicular with the main road centreline.
  - Any part of the headwall is less than 4m from the road edge of formation.
  - When Council determines that there is a risk of an errant vehicle colliding with the headwall at an undesirable angle.

  Council will consider removing the requirement for a sloped headwall where an approved safety barrier system in accordance with TfNSW and Austroads standards is provided to prevent errant vehicles colliding the headwall.
- Pipe grading across pits shall be designed on the following basis:
  - No change in direction or diameter - minimum 50mm.
  - Direction change but no change in diameter - minimum 70mm.
  - Changes in pipe diameter shall be graded from obvert to obvert.
- At pit connections, a 3m length of approved subsoil drainage pipe enclosed in a geofabric sock shall be placed alongside the main pipe to enter the pit at the same invert level and adequately drain the main trench, in accordance with standard drawing *EN7896*. This does not remove the requirement to provide pavement subsoil drainage to both sides of the road.
- Stormwater pits including covers shall be capable of supporting the following load classes defined by *AS 3996*:
  - All non-trafficable areas – Class B.
  - Any trafficable area – Class D.

4.4.1.2 Location of Kerb Inlet Pits

The following criteria govern the location of pits in roadways, for the adopted minor drainage system annual exceedance probability.

- Inlet pits shall be located to restrict the maximum gutter flow width to 2.5m.
- Maximum spacing between any two consecutive pits is 85m.
- Pit bypass flows shall be limited to 15% of the gutter flow at that location.
- At intersections, kerb inlet pits shall be constructed adjacent to the upstream kerb return tangent point where flows exceed 20l/s or gutter flow width is more than 1m.
- The minimum clearance from the top of the pit to the design pit water level shall be 150mm.
- The product of flow velocity and depth of flow in the kerb and gutter shall not exceed $0.4m^2/s$.
- Kerb inlet pits shall be located adjacent to common property boundaries clear of horizontal curves, footpath/cycleway/shared path routes and driveways.
- Inlet conditions shall be designed so that the potential for blockage by silt and debris is minimised. This may require special treatment of the inlet sump under some conditions.

4.4.1.3 Hydraulic Design

- Pit inlet capacities shall be estimated from design charts and formulae, based on lintel size for on-grade pits and depth of ponding for sag pits. The calculated inlet capacity shall be reduced by a factor of 50% for sag pits, and 20% for on-grade pits, on the assumption that debris is preventing some inflow.
- Standard lintel sizes of 1.8, 2.4, 3.0, or 3.6m shall be used.
- The minimum internal lintel size on a sag shall be 2.4m.
- The head loss through pits shall be determined from Missouri Charts or other recognised and approved methods.

4.4.2 Drainage Pipes

4.4.2.1 General Requirements

- The inlet and outlet of all pipe systems shall be fitted with approved headwalls and energy dissipating devices to provide protection against scouring, designed by a Certified Professional in Erosion and Sediment Control (CPESC).
- When constructing pipes under existing roads, pipelines shall crossroads perpendicular to the centreline. For new roads, the length of pipes beneath roads shall be minimised.
- All pipe supports shall be Type HS2 trench installation as defined in *AS 3725* and in accordance with standard drawing *EN7892*.
- Shall be installed with detectable underground warning tape in accordance with *AS 2648 – Underground marking tape* and *Section 1 – General, Clause 27*.

4.4.2.2 Diameter

- Pipes in public road reservations shall have a minimum diameter of 375mm in urban areas and 450mm in rural areas.
- For single cell pipeline systems of diameter less than 900mm, a downstream pipe of smaller diameter than the upstream pipe will not be permitted.

4.4.2.3 Material

- Under any trafficable surface or with cover less than 600mm or greater than 2400mm:
  - Class 4 rubber ring join reinforced concrete pipe in accordance with *AS 4058*.
- Not under any trafficable surface, but within road reserve and with cover greater than 600mm but less than 2400mm:
  - Class 2 rubber ring join reinforced concrete pipe in accordance with *AS 4058*.
- Not under any trafficable surface, not within road reserve and with cover greater than 600mm but less than 2400mm:
  - Class 2 rubber ring join reinforced concrete pipe in accordance with *AS 4058*.
  - Class SN8 rubber ring join PVC-U pipes in accordance with *AS 1260*.
  - Class SN8 rubber ring join polyethylene or polypropylene pipes in accordance with *AS 5065*.
- Where curved pipelines are approved, they shall be constructed using long-socketed rubber ring jointed pipes, installed strictly in accordance with the manufacturer's recommended radii, and must follow the service corridor as shown in standard drawings *EN7885* and *EN12046*.
- Pipe classes shall be checked for a given pipe diameter, cover, trench HS2 installation and loading, using *AS 3725, AS 4058* and/or *CPAA PipeClass Software*. Where these require a higher class of pipe than the minimum specified in these Guidelines, the pipe class specified shall be increased as required.

4.4.2.4 Gradient

- Pipes shall have a minimum grade of 1%, wherever physically possible, to permit self-cleansing under low flow conditions. Actual pipe velocity shall be greater than 0.6m/s for self-cleansing, and less than 8m/s to prevent cavitation and scouring.
- Pipe restraints shall be provided in accordance with *Clause 10.2.5* of this Section.

4.4.2.5 Alignment

- Centre of stormwater pipe alignment to be invert of kerb generally but may vary slightly to suit different one-piece kerb units.
- Where pits wider than 900mm are required to accommodate large pipes, custom pits shall be engineered to ensure that the outside of the pipe barrel is not more than 300mm behind back of kerb into the verge.

4.4.2.6 Cover and Clearance

- Pipes running parallel to the road centreline in a road reserve shall have a minimum cover of 1200 below invert of kerb level.
- Pipes running perpendicular to the road centreline in a road reserve or pipes not located within a road reserve shall have a minimum cover of 600mm or in accordance with manufacturers requirements where the manufacturer specifies a cover greater than 600mm based on the application and site conditions.
- The minimum clearance between stormwater drainage and adjoining services shall be 400mm in the horizontal plane, and 150mm in the vertical direction (or 300mm for high voltage electrical cables/high pressure gas pipes).

4.4.3 Subsoil Drainage

Subsoil drainage pipes shall be installed on both sides of all new flexible road pavements (independent from and in addition to stormwater trench subsoil drainage), graded at a minimum

longitudinal slope of 1% towards a suitable outlet, in accordance with standard drawings *EN7896* and *EN7897*. Where this slope is not achievable, guidance shall be obtained from Council.

Subsoil pipes shall be in accordance with the requirements of *AS 2439* and consist of a 100mm diameter slotted corrugated Class SN8 PVC pipe enclosed in a geofabric sock, bedded in a well graded filter material in accordance with *Clause 4.4.4* of this Section.

Flushout points shall be installed at the upstream end of the pipe, and at regular intervals a maximum distance of 100 metres apart.

4.4.4 Stormwater Pipe Bedding/Backfill Material and Subsoil Drainage Filter Material

All stormwater pipe bedding/backfill material and subsoil drainage filter material shall be a washed sand/aggregate material, free of organic matter that complies with the particle size distribution in Table 7.2.

TABLE 7.2 – Sand/Aggregate for Stormwater Pipe Bedding/Backfill Material and Subsoil Drainage Filter Material Particle Size Distribution

AS Sieve Size (mm)	Percentage Passing by Mass
9.5	100
6.73	70 – 100
4.75	50 – 100
2.36	40 – 100
1.18	30 – 65
0.6	12 – 40
0.30	0 – 16
0.15	0 – 4
0.075	0 – 3

4.4.5 Easements

Drainage easements shall be created pursuant to Section 88B of the Conveyancing Act, 1919, where stormwater drainage pipelines pass through, or concentrate water onto, private property. When conveying surface runoff from road reservations, such easements shall be in favour of Council. All other easements shall be in favour of the allotments benefited only.

The width of these easements shall be sufficient to contain all stormwater drainage infrastructure and provide for future maintenance requirements. The minimum widths of such easements are generally as follows:

Table 7.3 – Minimum Easement Widths

Type of Drainage	Minimum Easement Width (metres)
Piped Drainage	
150mm diameter	1.5
225 - 300mm diameter	2.0
375 - 600mm diameter	2.5
675 - 1050mm diameter	3.0
1200 - 1500mm diameter	3.5
1650 - 1800mm diameter	4.0
Twin Pipes	(2 * Diameter) + 2.5
Floodway / Open Channel	Surface width of 1% AEP flow + 0.5m freeboard + 1.0m horizontally

4.4.6 Special Provisions

4.4.6.1 Major Traffic Routes

Arterial routes shall be kept free of surface runoff in the 2% AEP flood event. Bridges and other major drainage structures shall be designed to pass the 1% AEP flood with freeboard of 500mm. Afflux and hydraulic gradients shall be determined in all cases. Note that bridges shall be designed in accordance with *Austroads Guide to Bridge Technology – Parts 1-7.*

Where surface flows cross a major road in the 1% AEP event, the maximum flow depth shall be limited to 150mm at the road centreline and maximum flow length of 10 metres.

4.4.6.2 Cul-de-Sacs

Cul-de-sacs, where the fall is towards the turning head, shall have a floodway reservation or formed pathway in accordance with standard drawing *EN9161*, at the sag point to ensure that major flows can be conveyed to a drainage reserve or overland flow path without flooding private properties.

4.4.6.3 Steep Grades

Close attention shall be given to the placement and location of drainage inlets to intercept surface water off steep grades. This particularly applies where a steep side street intersects a flat cross street. Mounding may be necessary opposite the intersection to protect properties from flooding, or a floodway reservation provided opposite the steep street. Pipe restraints are required for all piped drainage systems in accordance with *Clause 10.2.5* of this Section.

4.4.6.4 Energy Dissipation Structures

It will be necessary to provide energy dissipating devices on stormwater inlet and outlet structures, to minimise the effect of erosion in accordance with *Managing Urban Stormwater: Soils and Construction – Volume 1 (NSW Blue Book)*.

4.4.6.5 Rural – Residential Subdivisions

Rural residential subdivisions shall have an appropriate combination of natural drainage courses and constructed contour banks and channels, to control the flow of stormwater through the subdivision, up to and including a 1% AEP storm event, with 500mm freeboard.

4.5 ZONE OF INFLUENCE DESIGN FOR STORMWATER DRAINAGE

All stormwater drainage shall be designed with the zone of influence from any adjacent structures considered in accordance with *Section 1 – General, Clause 26*. Zone of Influence

design and construction plans shall be provided where relevant.

5. TRUNK DRAINAGE

Trunk drainage systems are typically large capacity channels, that carry stormwater runoff from local street drainage systems to receiving waters. They typically serve large areas and overtopping is likely to cause nuisance and/or property flooding.

Trunk drainage generally comprises floodways and open channels to cater for 1% AEP flood events, with 500mm freeboard. Floodways shall be located along existing water courses or drainage depressions, unless exceptional circumstances exist, and the prior approval of the Director of Engineering Services has been obtained.

5.1 CALCULATION OF FLOWS

Flows through a trunk drainage network shall be calculated using RAFTS or another appropriate runoff-routing computer model. The model shall be calibrated against a known discharge, or one calculated using a different method. Details of the method used to calibrate the model shall be submitted to Council with an electronic copy of the model results.

Once calibrated, the model shall be used to analyse the impact of the development on existing flows, based on zero initial and continuing loss rates.

For design of new channels, a fully developed catchment shall be assumed.

5.2 HYDRAULIC DESIGN

Open channels shall be designed using backwater calculations. A freeboard of 500mm above the 1% AEP flood level shall be adopted.

The Director of Engineering Services will consider requests to vary the required freeboard, based on the risk of damage to life and property in large flood events.

Terracing may be introduced into the floodway where ancillary land uses, such as sports ovals, are also available for conveying the design 1% AEP flood event.

The product of velocity and depth shall not exceed 1.0m^2/s in the 1% AEP event.

Centreline horizontal curves shall have a radius not less than twice the 1% AEP surface flow width, with a minimum of 30m.

Recommended values for Manning's Roughness Coefficient are 0.013 for concrete lined inverts, 0.03 for gabions, 0.035 for maintained grass channels, and 0.02 for clear earth.

5.3 LOW FLOW DRAINAGE

Low flow drainage shall be provided to all channels defined as "Maintenance Channels" in accordance with *Section 11 – Open Space Areas*. Generally, the primary function of maintenance channels is to perform engineering functions rather than environmental functions.

Maintenance channels shall be provided with a low flow pipeline, or concrete lined invert of equivalent capacity, to cater for flows with an AEP of 100%.

Low flow pipes shall have a minimum diameter of 450mm, and minimum longitudinal grade of 1%.

Road and interallotment drainage shall be connected to low flow piped systems using a surcharge pit as per standard drawing *EN7888*, sized to cater for the maximum discharge in the

sideline.

5.4 FLOW VELOCITIES

Piped low-flow systems shall have a minimum velocity of 0.6m/s for self-cleansing purposes. Grass-lined channels shall be designed to ensure sub-critical flow with a Froude Number no greater than 0.8. Maximum velocity shall be limited to 2m/s in the 5% AEP flood event, to prevent scouring. This velocity shall be reduced where necessary in highly erodible soils. Where necessary, drop structures shall be provided, or flow lengths increased, to reduce velocities to acceptable levels.

5.5 CHANNEL STABILIZATION

Permanent scour protection devices shall be designed for all discharge points into and out of the channel, and at all points where a significant change in flow conditions is likely.

Suitable species of grass shall be planted in open channels.

Approved measures shall be taken to ensure that erosion does not occur at interfaces between concrete and grassed sections.

Open channels shall be stabilised by turfing, hydromulching, or by installing a geotextile material having a minimum life expectancy of two years.

5.6 BATTER SLOPES

Batter slopes of grassed waterways shall be a maximum of 1:6 (vertical:horizontal). Reductions to 1:4 may be used where approved by Councils engineer.

Minimum crossfalls in channels shall be 2% with a depressed invert.

5.7 ROAD CROSSINGS

In urban areas, the length of culverts shall be extended to the width of the road reservation, so that the standard width verges are provided on either side of the road. Headwalls, wingwalls, aprons, handrails, guard rails, and safety barriers shall be provided in accordance with accepted practice, and relevant legislation and/or standards.

Trenches through existing roads shall be backfilled using a full depth, 27:1 sand:cement mixture as per standard drawing *EN7892*. Road crossings shall be constructed perpendicular to the road centreline.

5.8 HEADWALLS

Headwalls on trunk drainage systems shall have a headwall security grate installed with clear openings no greater than 150mm to prevent persons accidentally entering the system during flooding where any of the following conditions are met:

- The headwall is the entrance to a culvert or piped system longer than 40m.
- The headwall is the entrance to any piped system with a change in direction before re-entering an open channel.

6. OVERLAND FLOW PATHWAYS

Overland flow paths are required to convey runoff from major events to the trunk drainage system, without causing erosion, scouring or the like. All overland flow paths shall be designed to cater for the 1% AEP flood event without overtopping. These pathways shall not be required to convey any runoff in minor events.

The design overland flow path may consist of public roads, pathways, catch drains and open

spaces. Overland flow paths are not to be constructed over private property. For design purposes, the minor (piped) system shall be assumed to be fully blocked.

6.1 PUBLIC ROADWAYS

The catchment area feeding roads that also act as overland flow paths shall be limited, to satisfy public safety and roadway flow capacity criterion. In general, a standard 18.5m wide road reserve shall have a maximum catchment area of 20 to 30 hectares and be designed for a peak flow of 2.5m^3/s. The product of velocity and depth shall not exceed 0.4m^2/s.

Special care shall be exercised to ensure that continuity of flow is achieved, and that the floodway cross section is maintained at driveway entrances and the like.

Ready discharge shall be provided at the low point, and other relief points along the road, to quickly remove water and avoid ponding and deposition of gravel and silt.

Gutter flows on bus and arterial routes shall be limited to a maximum width of 2m, and depth of 125mm.

Overland flow paths shall, where practicable, be provided within open space areas in preference to roadways.

6.2 FLOODWAYS IN OPEN SPACE AREAS

A suitably designed depression or flow path shall be provided for the entire length of the floodway. This particularly applies to smaller footpath reserves designed as floodways. Special consideration shall be given to trapped low points where the overland flow path may divert surcharge into properties. This is especially important in the design of ‘downhill’ facing cul-de-sac, and kerb returns adjacent to a sag vertical curve.

Where possible, tree and shrub plantings within floodway reserves shall be located clear of the designed flowpath. If the use of shrubby plant material cannot be avoided, the floodway width shall be increased to accommodate this factor.

Concrete paths shall be kept clear of the main flood flow and be sufficiently thick and anchored to withstand the design discharge in areas of high velocity.

Grassed floodways shall be designed to avoid velocities more than 2m/s in the 5% AEP flood event. Concrete inverts, or other approved erosion control measures shall be designed and constructed where flow velocities are excessive.

The ponding of water along road embankments shall not be generally permitted. In exceptional circumstances where surface water cannot be conveyed to an appropriate outlet and will pond during minor AEP events prior to running to the appropriate outlet, the following conditions shall be complied with:

- The design shall cater for the ponded water to reach the appropriate outlet and increase flows during larger AEP events.
- Water shall only pond in the road reserve. Ponding shall not encroach into private property and property levels shall be 500mm above the 1% AEP flood level.
- The safety of the embankment during larger AEP events shall be considered, especially if there is a hazard to urban development or if a roadway or other structure diverts flow away from the appropriate outlet.

Where practical, open spaces and retarding basins shall be strategically designed on a whole-catchment basis to improve downstream flow conditions and reduce flow velocities.

For major grassed channels and natural floodways, signage shall be provided as shown in Figure 8.1 at all principal means of pedestrian access to the creek or floodway, advising people to take care at certain times. These signs shall include black lettering on white reflective plate and have dimensions of 450mm x 600mm. The graphic is a 300mm triangle depicting a child in trouble within blue water.

Figure 8.1 – Floodway Signage

7. RETARDING BASINS

Where the downstream hydraulic capacity of one or more components in a drainage system is inadequate for the design flow, and/or where economically feasible, retarding basins are required at the discretion of the Director of Engineering Services.

7.1 DUAL USE

Basins shall incorporate multiple land uses such as recreational open space where possible. However, landscaping and permanent structures shall be designed with due consideration of the basin's prime drainage function. Where possible, the floor of the basin shall be designed to have a minimum slope of 1%.

Where recreational uses are proposed, the basin shall be provided with low-flow drainage pipes or channels, each having minimum longitudinal grades of 1%. Advisory signs shall be erected, warning of the intermittent safety hazard.

7.2 DESIGN

While basins are generally designed and constructed to a specific brief, the general requirements in this Clause apply.

7.2.1 Annual Exceedance Probability

The design shall be based on a critical storm event with an AEP of 1%, however consideration shall be given to the provision of non-catastrophic failure mechanisms and public safety up to the Probable Maximum Flood (PMF) event.

The design flood shall be passed entirely through a controlled system, and no uncontrolled outflow shall occur. Defined spillways shall be provided for flows more than the design flood.

Basin shall be sized depending on the degree of flow attenuation necessary to ensure that the downstream drainage system can pass the design storm event.

7.2.2 Embankments and Batters

Grassed batters and embankments shall be no steeper than 1:6 (vertical:horizontal) for maintenance purposes, although steeper slopes may be accepted by Councils engineers in

special circumstances.

All pipelines under embankments shall be rubber-ring jointed, and consideration shall be given to the provision of suitable cut-off walls or seepage collars.

7.2.3 Water Levels and Freeboard

Where suitable land is available, basins shall be designed for a maximum 1.2m depth of water in the 5% AEP flood event. Where constraints preclude this, the designer shall ensure that adequate safety precautions have been taken, such as the provision of raised refuge mounds, fences, and warning signs.

A freeboard of 500mm above the 1% AEP flood level shall be incorporated into the basin embankment, unless otherwise approved.

7.3 HYDRAULIC ANALYSIS

When calculating inflows, a fully developed catchment shall be assumed. Basins shall be analysed using a suitable reservoir routing runoff model, such as RORB or RAFTS, using a recognised method. The model shall be calibrated using either the Rational or Unit Hydrograph method.

The designer shall ensure that at no time will the basin outflow interact with the downstream system to produce peak flow rates above the capacity of the system.

Backwater profiles shall be checked to ensure that flood waters do not back up onto roads and properties in the 1% AEP event.

7.4 SPILLWAYS AND OUTLETS

Spillways shall be designed to pass the 1% AEP and PMF events with minimal damage and no catastrophic failure.

Special attention shall be given to the surfacing of spillways using turf, concrete, stone pitching, gabions, or other approved low-maintenance, durable materials.

Outlets shall be designed to minimise the risk of blockage. Clear access for machinery shall be provided to permit removal of silt.

8. PROPERTY DRAINAGE

Property drainage systems are designed to convey surface runoff from roofs, paved areas, and other surfaces to a suitable outlet. Property drainage systems shall be designed so that all runoff can drain naturally to the street gutter, interallotment drainage system, or road drainage system. Hydraulically ‘charged’ roof water systems, where the pipe outlet is at a higher elevation than some parts of the pipe invert, are not permissible within the Council area, as sediment and debris will tend to block the pipe.

At subdivision stage, all allotments which do not have interallotment drainage shall have two 100mm diameter stormwater pipes with kerb convertors installed in accordance with standard drawings *EN7894* and *EN12046*.

Easements to drain water must be created where any component of the stormwater drainage system is located within adjoining, privately-owned lands.

Two guiding principles which shall be adhered to when designing property drainage systems are:

- Cause no detriment to downstream properties by either increasing, concentrating, or diverting flows.
- Cause no detriment to upstream properties by ponding or damming flows.

AS 3500 provides guidance for the design and construction of property drainage systems.

Note that stormwater shall be piped to the underground system whenever the discharge flowrate at the gutter is more than 30L/s per allotment, in a 5% AEP storm event.

Council is not responsible for the maintenance of property drainage systems.

8.1 BUILDING FLOOR LEVELS

The floor level of new buildings shall be carefully selected so that flood damage does not occur in major storm events. Houses shall not be cut into the finished subdivision levels, or located within a natural drainage depression, unless provision has been made for surface runoff to safely bypass the dwelling.

Those properties which are located on the low side of the public road, or adjacent to road sag points and drainage structures, shall also take particular care when selecting the design floor level, in anticipation of a pit surcharge during major flow events.

Building works shall be designed to protect the dwelling, all site embellishments, and neighbouring properties, from inundation.

8.2 BUILDING ADJACENT TO OVERLAND FLOW PATHS

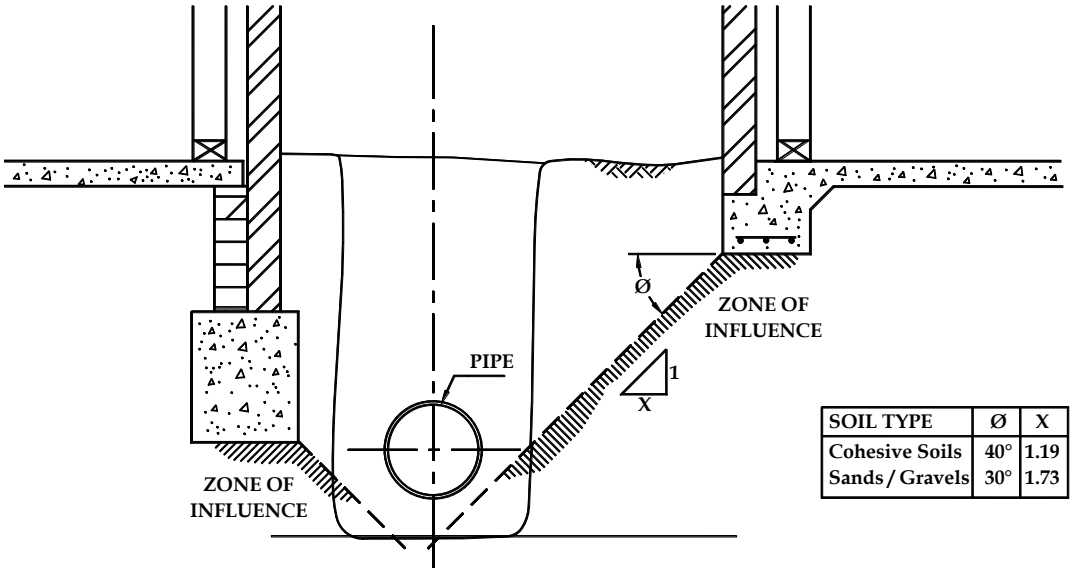
The floor level of properties located adjacent to overland flow pathways, trunk drainage channels, and natural streams shall be located a minimum 500mm above the top of bank level, or the surface of the 1% AEP design flood event, whichever is the greater.

8.3 DRAINAGE EASEMENTS AND ZONE OF INFLUENCE

Easements are generally created over all pipelines conveying road and interallotment drainage. Where road water is conveyed within an easement, generally no construction shall occur on or above the easement.

Construction works within stormwater easements may be considered by the Councils engineer, provided that the below criteria are met:

- The stormwater pipe's condition shall be surveyed (using CCTV or similar) and evidence of this survey presented to Council. The survey shall extend 3m, or past the zone of influence (whichever the greater) beyond the structure. Where the pipe condition is not acceptable, or comprises flush jointed pipes, the Developer will be required to replace the stormwater main with a size and material type as directed by Council.
- The stormwater system shall be designed for a 1% AEP storm event, with the incorporation of a defined overland flow path to provide for stormwater system failures.
- Structural loads shall be transmitted to the foundations outside of the zone of influence, as depicted in Figure 8.2 below. Concrete encasement of the pipe may be approved by the Councils engineer in special circumstances, where some additional loads on the pipe are unavoidable. See standard drawing *EN7902* for details.
- Maintenance access shall be provided.
- A Flood Impact Assessment shall be carried out, considering major event storms and system failure, to determine the effect upon the proposed construction works and neighbouring properties.



SOIL TYPE	Ø	X
Cohesive Soils	40°	1.19
Sands / Gravels	30°	1.73

Figure 8.2 – Zone of Influence

8.4 INTERALLOTMENT DRAINAGE

Interallotment drainage systems are required whenever the lowest point in a building allotment cannot be drained directly to the street gutter. These pipes are designed to drain both roof water and surface water to Council's underground drainage system.

Council is not responsible for the maintenance of interallotment drainage systems unless the easement over the system is in favour of Council as the system is conveying surface runoff from road reserves.

8.4.1 General Requirements

- The interallotment drainage system shall be designed using the same principles as road drainage, based on a fully developed catchment area.
- Where existing allotments discharge runoff directly onto the development site, an interallotment drainage system (with appropriate easements) shall be provided to alleviate this runoff.
- Easements shall be provided over all interallotment drainage in accordance with *Clause 4.4.5* of this Section.

8.4.2 Pits

- Square grated surface inlet pits, of minimum size 600mm x 600mm, shall be provided at a suitable location on each affected allotment. The pit surface level shall be designed for the finished surface level of the property, considering likely cut and fill operations during building works.
- Pits deeper than 1m to have minimum internal dimensions of 900mm x 900mm for access.
- Pits deeper than 1.2m to have step irons for safe access.
- Two building stubs shall be provided to all interallotment pits installed for the purpose interallotment drainage at subdivision stage in accordance with *EN7889*.
- Pits shall be provided at all changes in level, grade, and direction, and at all pipe junctions. Notwithstanding these requirements, the maximum pit spacing shall be 85m.

8.4.3 Pipes

- For minor developments and urban residential subdivisions of lot size not more than 800m^2, the following guide may be used to determine the minimum permissible pipe diameter:

Table 7.4 – Minimum Pipe Diameter for 1-5 Lots

Number of lots	Minimum pipe size	Minimum pipe grade (%)
1 - 2	150 mm	2
3 - 5	225 mm	1

Detailed designs and calculations are required for medium density developments, and subdivisions of more than five allotments.

- Pipes shall nominally be located 1m from side and rear property boundaries. Where sewer lines are laid parallel with interallotment drainage lines, the drainage line shall be located closer to the property boundary.
- Cover shall be in accordance with *Clause 4.4.2.6* of this Section.
- Pipe material and class shall be in accordance with *Clause 4.4.2.3* of this Section.
- Pipes shall be laid at a minimum longitudinal grade of 1%.
- In steep terrain, pipe restraints will be required in accordance with *Clause 10.2.5* of this Section.

8.4.4 Pump-out systems

Pump out stormwater systems are not permitted.

8.5 ABSORPTION TRENCHES

Absorption trenches may be constructed in rural or rural-residential areas, where the property area and soil types are suitable, and no nuisance will be caused to neighbouring properties. Absorption trenches are not acceptable in new urban areas.

The sizing of “soakaways”, absorption, or seepage trenches is dependent on the hydraulic conductivity of the soils, and the consequences of any surcharging.

9. LANDSCAPING TRUNK DRAINAGE SYSTEMS

Where landscaping of trunk drainage systems is required, see *Section 4 – Site Restoration and Landscaping* and *Section 11 – Open Space Areas*.

10. STORMWATER DRAINAGE CONSTRUCTION

10.1 EARTHWORKS AND BACKFILLING

10.1.1 General

Generally, earthworks shall comply with *Section 5 - Earthworks*.

10.1.2 Stormwater Trench Excavation and Backfill

Stormwater drainage trenches shall be excavated in accordance with standard drawing *EN7892*. The Developer shall further excavate, where necessary, to allow the box sections and/or pipes to be properly handled, jointed, packed and to permit the free use of caulking tools and to facilitate backfilling around the box and/or pipe. The bottom of the trench shall be neatly trimmed to give the pipes a uniform bearing for the whole of the length of each pipe and allow the placing

and compaction of not less than 100mm of approved bedding material as per the standard drawing listed above.

Stormwater drainage trenches shall be backfilled with materials as specified in the standard drawing *EN7892*, in layers not exceeding 200mm uncompacted thickness with a vibrating plate or other approved method. This includes backfilling with approved stabilised sand (sand:cement mixed at 27:1) batched and delivered by an approved concrete plant under all existing roadways.

10.1.3 Stormwater Pit Excavation and Backfill

All stormwater pits shall be excavated so that there is a minimum of 400mm between the outside of the pit and the side of the trench. The Developer shall further excavate, where necessary, to allow the pit to be properly handled, jointed, packed and to permit the free use of caulking tools and to facilitate backfilling around the pit.

All stormwater pits shall be backfilled with materials as specified in the standard drawing *EN7892*, in layers not exceeding 200mm uncompacted thickness with a vibrating plate or other approved method. This includes backfilling with approved stabilised sand (sand:cement mixed at 27:1) batched and delivered by an approved concrete plant under all existing roadways.

10.1.4 Unsuitable Bedding Subgrade Material

Where the subgrade excavation level consists of material which, when compacted at optimum moisture content, would be of insufficient bearing value, or for any other reason, as deemed by the Council's Engineer which constitutes unsuitable subgrade material, the Developer shall excavate to such further depth as directed by the Council's Engineer, backfill with an approved suitable material and provide a subgrade of acceptable bearing capacity.

Unsuitable material shall be replaced with granular or other approved fill material placed in layers not exceeding 200mm uncompacted thickness and compacted to 98% of the standard maximum dry density, when tested in accordance with *AS 1289*.

10.2 PIPES

10.2.1 Handling

The methods used for handling, laying and stacking pipes and pits shall be such as to avoid damage to the pipes, pipe coating and lining, pits, and shall comply with any recommendations made by the manufacturer. Cranes, skids or other approved devices shall be provided and used to ensure that pipes and pits are not dropped or bumped during loading, cartage, unloading or when being placed in the trench. Pipes shall not be lifted or suspended from hooks, lifting dogs, or other devices placed at their ends.

10.2.2 Bedding

Bedding material shall comply with *Clause 4.4.4* of this Section. The material shall be compacted to the bottom of the trench at the correct level for pipe laying.

"Bell-Holes" shall be excavated under each joint. Care shall be exercised that the pipes are evenly bedded and supported along the length of barrel of the pipe and that a 20mm clearance is maintained between the underside of the pipe collar and the bottom of the "Bell-Hole". Under no circumstances are pipes to be laid on their collars. After the pipe has been bedded to approval and the joint has been made, the recess under the bell shall be refilled with bedding material.

10.2.3 Laying

The methods used for pipe laying, jointing and installation of fittings shall conform to manufacturers specifications, particularly with respect to depth of entry of spigot ends. All cut ends of pipes shall be properly chamfered before joints are made.

The pipes shall be laid and jointed accurately to lines, gradients and levels shown in the approved drawings. All pipes shall be laid in such a manner that pipe barrels have solid bearing throughout their length.

Before pipes are laid, all dirt and foreign material that may have entered the pipe shall be removed and the outside of spigots and inside of sockets thoroughly cleaned of foreign matter.

Unless otherwise approved, laying shall commence at the low points of the pipelines and proceed uphill. All pipes shall be layed with collars in the upstream direction.

Where two or more lines of pipe are to be laid side by side, the space between the lines of pipe shall be of a width of 300mm, unless otherwise specified or shown on the approved drawings.

All open ends of pipeline stubs shall be blanked and closed off before backfilling commences.

10.2.4 Jointing

Rubber ring joints for pipes shall be formed by placing the rubber ring evenly over the spigot end of the pipe and rolling it into the socket, care being taken to ensure that the joint is free from dirt or other obstructions and that the rubber ring is placed evenly in the joint. Rubber ring joints shall be fitted in the manner described by the manufacturer.

All holes provided in concrete pipes for lifting or handling purposes shall be plugged with concrete bungs supplied by the manufacturer. All holes shall be plugged to the satisfaction of Council's Engineer prior to the backfilling of trenches.

10.2.5 Restraining/Anchoring

Steeply inclined pipelines with flexible joints shall be secured by pipe restraints in accordance with the Tables 7.5.1 and 7.5.2 below and standard drawing *EN7895*. Unless otherwise specified or directed by Council's Engineer, where the pipe joints are not designed to withstand longitudinal forces, the concrete bulkheads shall be spaced in accordance with Tables 7.5.1 and 7.5.2.

TABLE 7.5.1 – Non-Concrete Stormwater Pipe Anchoring Measures

Gradient	Anchoring Measures and Maximum Spacing (m)
Less than 6.5%	No anchoring required
6.5% to 10%	Trench stop (1) every third collar
10% to 15%	Concrete bulkheads (2) spaced no greater than 100 divided by the pipe gradient expressed as a %. Example for pipe on 12.5% grade: 100 ÷ 12.5% = 8m spacings
15% to 25%	Concrete bulkheads (2) spaced no greater than 100 divided by the pipe gradient expressed as a % multiplied by 2. Example for pipe on 20% grade: 100 ÷ (20%x2) = 2.5m spacings
Greater than 25%	Not permitted

TABLE 7.5.2 – Concrete Stormwater Pipe Anchoring Measures

Gradient	Anchoring Measures and Maximum Spacing (m)
Less than 15%	No anchoring required
15% to 25%	Concrete bulkheads (2) spaced no greater than 100 divided by the pipe gradient expressed as a %. Example for pipe on 20% grade: 100 ÷ 20% = 5m spacings
Greater than 25%	Not permitted

(1) – trench stops shall be polyethylene bags with a minimum thickness of 0.25mm filled with clay or other approved material, sealed in an approved manner, placed under, around and to 300mm above the pipe at every third collar. Bags shall not be placed on sand bedding.
(2) – concrete bulkheads shall be constructed in accordance with standard drawing *EN7895*.

10.3 STORMWATER STRUCTURES

10.3.1 General

All pits, headwalls and other structures shall conform with the requirements of Australian Standards and any relevant standard drawing.

10.3.2 Formwork

Where pits are to be formed insitu, formwork shall comply with the requirements of Australian Standards. Both internal and external surfaces shall be formed, and the surrounding ground will not be used as a form under any circumstance. Formwork shall be used at the end of all walls.

10.3.3 Alterations to Existing Structures

Where existing structures are raised or lowered, break out enough concrete to expose reinforcing to at least 150mm below the new cover or frame. Slice new reinforcing to existing and form and place concrete as specified for the new structures.

10.3.4 Steel Fixtures

Where grates, frames, step irons, ladders etc are specified, they shall be hot dip galvanised in accordance with Australian Standards.

10.3.5 Sealed Pits

Where sealed pits are specified, they shall be constructed as per standard pits, but with sealed lids to prevent the ingress of water.

10.3.6 Walls

Where wall structures are constructed/supplied with weepholes the Developer shall supply and install filter material in accordance with *Clause 4.4.4* of this Section, a minimum of 400mm wide and to the full height of the wall.

Handrail or Balustrade shall be provided to the requirements of *Section 1 – General, Clause 25*.

10.3.7 Gross Pollutant Trap

See *Section 12 – Water Sensitive Urban Design* for gross pollutant trap requirements.

10.4 SUBSOIL DRAINAGE

10.4.1 Bedding and Laying

Bed and lay pipes in accordance with standard drawing *EN7896* and to manufacturers specifications. Bedding material shall comply with *Clause 4.4.4* of this Section. The material shall be placed and compacted to the bottom of the trench at the correct level for pipe laying.

Minimum pipe grade will be 1% unless otherwise specified or approved by Council's Engineer.

Approved geofabric filter lining will be applied to the extents of the trench where required by standard drawing *EN7896* or detailed on the approved drawings.

10.4.2 Finishing

Discharge drains to pits, open drains or the surrounding surface as detailed on the approved drawings or directed by Council's Engineer. Where invert levels are not specified, the subsoil drain obvert shall not be lower than the highest obvert of stormwater pipes at the point of connection.

Provide flushout points, cover lids and outlet structures in accordance with standard drawing *EN7897*.

11. TESTING & SURVEY REQUIREMENTS

Where testing and survey items are specified by Consent Conditions or Council's engineer, the Developer shall arrange for the testing to be undertaken. Testing shall be treated as a hold point in the development and subsequent works shall not proceed until approval has been given.

Where specified, tests shall be undertaken in accordance with Australian Standards by a NATA approved testing laboratory. All test results from the NATA approved testing laboratory shall be filed and provided to Council, regardless of the results of the testing.

11.1 MATERIALS

All materials shall be proven to be compliant with the requirements of this Section by provision of material specifications and/or NATA laboratory testing.

11.2 TESTS & SURVEY

- Stormwater pipe bedding/backfill material and subsoil drainage filter material testing to confirm compliance with *Clause 4.4.4* of this Section by NATA laboratory.
- Trench backfill supervision by Level 1 GITA or SMDD testing by Level 2 GTA or NATA laboratory.
- Works as executed survey by registered surveyor.

11.3 CLOSED CIRCUIT TELEVISION (CCTV) INSPECTIONS

Where stormwater drainage has been constructed in the development, the Developer will be required to carry out a colour CCTV inspection as detailed in this Clause.

The colour CCTV inspection shall include cleaning of the drainage network. The cleaning equipment used shall be capable of removing dirt, grease (fat), rocks, sand, surface encrustations and other material and any obstructions from the pipes and pits. Passing material from pit to pit shall not be permitted. The Developer shall be responsible for the proper disposal of the waste material.

The initial cleaning pass pressure shall not be greater than 800psi. Subsequent passing may be

carried out at a higher pressure, but the Developer shall be responsible for rectifying any damage.

Distance measurement, in all instances, shall commence from the pit/pipe entry to the end of the pipe section being surveyed. The camera and illumination system shall be capable of providing a clear, accurate and in-focus record of the pipe's internal condition.

At the start of each pit length, the following additional information shall be electronically generated and displayed:

- Street Name
- Start & Finish Pit/Node Numbers
- Direction of survey from pit to pit
- Diameter of pipe and material type
- Date of Survey

A copy of the videotape in .avi or .mp4 format along with an inspection report in PDF format will be required to be provided to Council's engineer in a portable USB flash drive or DVD.

All defects identified in the CCTV footage are to be repaired at full cost to the Developer to the satisfaction of Council's engineer.

11.4 TESTING & SURVEY SPECIFICATIONS

All items listed in *Clause 11.3* of this Section shall comply with the requirements of this Clause. Tables 7.6 to 7.9 detail the required test types, results, tolerances and frequencies of testing.

TABLE 7.6 – Required Tests and Survey Description

Item	Required Tests and Survey Description
Stormwater pipe bedding/backfill and subsoil drainage filter material	• Particle size distribution test in accordance with *AS 1289*.
Trench backfill	• SMDD compaction test to *AS 1289*.
Works as executed survey	• All installed stormwater pits/outlet structures shall be surveyed to show centre and full extent of structure. • All installed stormwater pits/outlet structures shall be surveyed to show top and invert level. • All installed stormwater pipes/box culverts shall be surveyed to show invert level at pits/outlet structures. • All subsoil drainage flushout points, cover lids and outlet structures shall be surveyed to show centre and extent of structure.

TABLE 7.7 – Required Results

Item	Required Results
Stormwater pipe bedding/backfill and subsoil drainage filter material (1)	• Particle size distribution to comply with *Clause 4.4.4* of this Section.
Trench backfill (2)	• SMDD shall be 98% at ± 2% optimum moisture content.
Works as executed survey (3)	• Top and invert level of stormwater pits/outlet structures shall target design. • Centre location of stormwater pits/outlet structures shall target design. • Invert levels of stormwater pipes/box culverts at pits/outlet structures shall target design.

(1) – if material does not meet the requirements, an alternate material shall be sourced.

(2) – failure to achieve any of the required results means non-compliance for the trench, 50m in each direction of the failed test or between the two service pits.

(3) – see Tables 7.8 for tolerances.

TABLE 7.8 – Stormwater Drainage Level and Alignment Tolerances

Item	Tolerance
Top and invert level of pits/outlet structures	No more than 20% of survey points to be outside of ± 40mm of design
Centre location of pits/outlet structures	No more than 10% of all survey points to be outside of ± 50mm of design
Pipe invert levels at pits/outlet structures	No more than 20% of survey points to be outside of ± 40mm of design

TABLE 7.9 – Required Test Frequencies for NATA Laboratory Works

Item	Required Frequency
Stormwater pipe bedding/backfill and subsoil drainage filter material	• One test and inspection every 250m^3.

Trench backfill	• SMDD tests shall be undertaken for every second layer with the following requirements:
	  ○ One test every 40m of trenching, including at least one test between all service pits/changes in direction.
	  ○ For each placed layer, the testing location will be randomly changed from the location of the test on the previous layer.

SECTION 8 - WATER INFRASTRUCTURE

1. INTRODUCTION

This Section of the Guidelines for Engineering Works outlines Council's requirements for the design and construction of water infrastructure. It shall be read in conjunction with the relevant Water Services Association of Australia (WSAA) publications, Public Works Advisory NSW standards and manufacturers recommended procedures.

2. STANDARDS AND REFERENCES

Unless otherwise specified or approved, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standards listed in this Section.

Standards include, but are not limited to:

- *AS 1141 – Methods for sampling and testing aggregates*
- *AS 1281 – Cement mortar lining of steel pipes and fittings*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 1432 – Copper tubes for plumbing, gasfitting and drainage applications*
- *AS 1646 – Elastomeric seals for waterworks purposes*
- *AS 2129 – Flanges for pipes, valves and fittings*
- *AS 2280 – Ductile iron pipes and fittings*
- *AS 2419 – Fire hydrant installations*
- *AS 2439 – Perforated plastics drainage and effluent pipe and fittings*
- *AS 2566 – Buried flexible pipelines*
- *AS 2638 – Gate valves for waterworks purposes*
- *AS 2648 – Underground marking tape*
- *AS 2845 – Backflow prevention devices*
- *AS 3500 – Plumbing and Drainage*
- *AS 3565 – Meters for water supply*
- *AS 3680 – Polyethylene sleeving for ductile iron piping*
- *AS 3681 – Application of polyethylene sleeving for ductile iron piping*
- *AS 3688 – Water supply and gas systems – Metallic fittings and end connectors*
- *AS 3718 – Water Supply – Tap ware*
- *AS 3952 – Water supply – Spring hydrant valve for waterworks purposes*
- *AS 3996 – Access covers and grates*
- *AS 4020 – Testing of products for use in contact with drinking water*
- *AS 4041 – Pressure piping*
- *AS 4087 – Metallic flanges for waterworks purposes*
- *AS 4158 – Thermal bonded polymetric coatings on valves and fittings*
- *AS 4181 – Stainless steel clamps for waterworks purposes*
- *AS 4331 – Metallic flanges*
- *AS 4793 – Mechanical tapping bands for waterworks purposes*

- *AS 4794 – Non-return valves for waterworks purposes*
- *AS 4795 – Butterfly valves for waterworks purposes*
- *AS 4796 – Water supply – Metal-bodied and plastic-bodied ball valves for property service connections*
- *AS 4809 – Copper pipe and fittings – Installation and commissioning*
- *AS 4956 – Air valves for water supply*
- *AS 4998 – Bolted unrestrained mechanical couplings for waterworks purposes*
- *Australian Drinking Water Guidelines*
- *Water Services Association of Australia – Water Supply Code of Australia*

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN7883 – Trench Shielding Requirements*
- *EN7885 – Urban Road Verge Allocation Detail Pre-September 2023*
- *EN7895 – Pipe Restraint & Concrete Bulkhead Details*
- *EN7902 – Zone of influence Diagram and Pipe Concrete Encasement Details*
- *EN7903 – Water Hydrant and Valve Details*
- *EN7904 – Water Pipe Bedding & Backfill Details*
- *EN7905 – Water Thrust Block and Anchorage Details*
- *EN7906 – Water Service Crossing and Meter Connection Details*
- *EN7907 – Water Covers, Indicator Posts and Markers Details*
- *EN7908 – Water Reticulation for Cul-de-sacs*
- *EN12046 – Urban Road Layout & Verge Details in Greenfield Sites from 21 September 2023*
- *EN12076 – Water Main Pressure Reduction Valve Details*

3. SUBMISSION OF ENGINEERING DRAWINGS

Engineering drawing submissions shall include all information requested in *Section 1 – General, Clause 5* and detail all works necessary to extend water infrastructure such that each lot includes a water service located entirely within the property boundary and the main to be extended just past the extent of the subdivision boundary.

3.1 PLAN

Water plans shall be drawn at a standard scale not greater than 1:500 sufficient to show all necessary details. The following information shall be included:

- Boundaries of allotments, roads, paths, easements, and reserves.
- Allotment numbers.
- Street names.
- Location of water main and all fittings (hydrants, valves, tees, tapers etc.).
- Road centreline chainages.
- Existing water mains, and all other utility service lines crossing the main.
- Pipe class, diameter and material.
- North point and bar scale.

Longitudinal sections along the centreline of all water mains may be required in undulating terrain, or where necessary to show the arrangement of pipe bends and other fittings. These sections shall include pipe class, diameter and material, and the reduced level of the pipe invert and design surface at 20m intervals, and at all high points, low points, and pipe junctions. Where other utility services cross the water main, their location and size shall be shown.

3.2 STRUCTURES

Detailed engineering drawings and supporting information will be required for any structures such as reservoirs and pumping stations proposed for construction with water supply works.

Designs and construction shall comply with Water Services Association of Australia (WSAA) and/or Public Works Advisory NSW standards. Developers are advised to contact the Director Engineering Services at an early stage to discuss the requirements of Council.

3.3 CALCULATIONS

Calculations showing water demand and anticipated flow conditions shall be submitted for approval with the engineering drawings, by persons qualified in accordance with *Section 1 – General, Clause 5.2*.

4. GENERAL DESIGN REQUIREMENTS

Council requires that all allotments, including areas set aside for recreation, be provided with a reticulated water supply sufficient for both domestic and fire-fighting purposes. All open space areas shall also be provided with a water service for irrigation purposes.

4.1 WATER DEMAND

The design water demands shall be calculated in accordance the Water Services Association of Australia (WSAA) and/or Public Works Advisory NSW standards. The design must cater for proposed future development in accordance with Council's Local Environmental Plan. Pressure and flow must be suitable for both domestic and fire-fighting requirements.

4.2 SERVICE RESERVOIRS

The minimum capacity is one day's supply at peak demand.

Designs and construction shall comply with Water Services Association of Australia (WSAA) and/or Public Works Advisory NSW standards. Developers are advised to contact the Director Engineering Services at an early stage to discuss the requirements of Council. Internal and external lockable ladders must be provided to the relevant Australian Standard and WorkCover requirements. The roof must be bird-proof and incorporate either full railing or handrails around the lockable access hatch.

The scour line must be installed through a pit, followed by a rubble drain, and erosion control measures provided to prevent scouring.

NSW WorkCover approved fall arrest systems covering the whole of the reservoir shall be provided.

4.3 RETICULATION MAINS

The minimum static head required to each lot is 30m when the reservoirs are one-third depleted.

The main shall also be capable of delivering peak instantaneous demand to each lot, at a minimum head of 15m measured at the property water meter, with the service reservoirs two-thirds depleted.

Mains shall be extended to the extremities of the subdivision or development to allow for future

extensions, without disturbing established areas.

Mains shall be provided on both sides of the road in commercial and industrial areas.

4.4 ALIGNMENT

Water mains shall be located within the verge with the pipe centreline aligned as shown in standard drawings *EN7885 and EN12046*.

4.5 EASEMENTS

Where any watermain or water service is not located on a public road, a 3m wide easement, with the pipe(s) centrally located shall be created in favour of Council.

4.6 MATERIAL, SIZE, AND COVER REQUIREMENTS

4.6.1 Pipes

All water pipes shall be one of the types specified below and meet all requirements detailed.

4.6.1.1 Spigot and Socket Mains

Spigot and socket mains shall be rubber ring jointed ductile iron concrete lined (DICL) pipe in accordance with *AS 2280* with the following additional requirements as a minimum:

- Shall be the following classes based on diameter:
  - Up to 300mm diameter – Class PN20.
  - 300mm diameter or greater – Class PN35.
- The socket shall be patented “TYTON” elastomeric seal spigot-socket joint.
- The spigot shall be provided with a chamfer in accordance with the manufacturer’s specifications for the “TYTON” socket joint.

4.6.1.2 Flanged Mains

Flanged mains shall be ductile iron concrete lined (DICL) pipe in accordance with *AS 2280* with the following additional requirements as a minimum:

- Shall be the following classes based on diameter:
  - Up to 300mm diameter – Class PN20.
  - 300mm diameter or greater – Class PN35.
- Flanged joins shall be sealed with the manufacturers elastomeric gasket and tightened to the specified torque.

Pipes shall be sized according to the calculated demand flows; however, the minimum acceptable pipe diameter is 100mm. Pipes with diameter of not less than 150mm shall be used in commercial, industrial and rural residential areas.

Minimum cover to pipes shall be 800mm or in accordance with manufacturers requirements where the manufacturer specifies a cover greater than 800mm based on the application and site conditions.

The minimum clearance between water mains and adjoining services shall be 400mm in the horizontal plane, and 150mm in the vertical direction (or 300mm for high voltage electrical cables/high pressure gas pipes).

4.6.2 Fittings

Water pipe fittings shall be ductile iron concrete lined (DICL) in accordance with *AS 2280* and have the following properties:

- All fittings shall comply with *AS 2280* and class shall match the requirements for pipe being installed.
- All hydrants and valves shall be in accordance with standard drawing *EN7903, AS 2280* and *AS 2638*.
- All fittings for use with spigot and socket ductile iron pipes shall be spigoted, long type fittings, except hydrant tees, which shall be spigot/flange fittings.
- All fittings for use with flanged pipes shall be flanged, type E insulated, long type fittings.
- Gibault fittings are not to be used for new works unless approved by Council's Engineer in writing. Where approved, they shall be long sleeved.
- Backflow prevention devices shall comply with *AS 2845*.

Council endeavours to standardise fittings so that maintenance and repair stocks can be minimised. It is important that Developers obtain details of approved manufacturers prior to ordering pipe fittings.

4.6.3 Service Connections

Water services shall be in accordance with standard drawing *EN7906*. Water services shall be of single service drawn copper pipe, Type A, manufactured in accordance with *AS 1432*. Services shall be a minimum of 20mm diameter, with 1.4mm wall thickness for residential areas. Services for rural residential areas, commercial and industrial shall be a minimum of 25mm diameter.

Brass or copper capillary fittings shall be installed at all joints, branches, and bends.

Tapping bands shall be constructed from cast iron, comply with *AS 4793* and be approved by Councils Engineer. Materials other than cast iron are non-compliant.

Main cocks shall be a capped TPFNRS fitting compliant with *AS 3718* approved by Councils Engineer. TPFNRS fittings shall be pressure rated to PN16 minimum.

Meter cocks shall be a gland pack stop tap male & female brass fitting compliant with *AS 3718* approved by Councils Engineer. Any taps other than gland pack type are non-compliant.

Each individual allotment will be serviced by one water service only and to the size adequate to service that allotment.

4.6.4 Polyethylene Sleeving

Where DICL pipe is to be installed in areas containing aggressive soils, polyethylene sleeving shall comply with the requirements of *AS 3680* and *AS 3681* and meet the following additional requirements:

- Be "Tyton Polyboss" or approved equivalent.
- Have a minimum thickness of 0.2mm.
- Have a minimum ultimate tensile strength of 50N.
- Have an impact resistance greater than 900g.
- Have tear resistance greater than 25N.
- Be blue in colour.
- Tape used on sleeving shall be PVC duct tape, be a minimum of 0.18mm thick, be a minimum of 50mm wide and shall not be black in colour.

4.6.5 Jointing Seals

All jointing seals to be supplied for use shall comply with *AS 1646*.

All flange insertion gaskets to be supplied with for use shall comply with *AS 4087*.

4.6.6 Water Meters

All meters shall be in accordance with standard drawing *EN7906* and *AS 3565*.

4.6.7 Thrust Blocks

- All thrust blocks shall be constructed from concrete with a minimum strength of 25MPa.
- All thrust blocks for mains up to 150mm shall be in accordance with standard drawing *EN7905*.
- Thrust blocks for mains larger than 200mm and for mains in unstable ground conditions shall be specifically designed/engineered for location.

4.6.8 Covers, Indicator Posts and Markers

All covers, surrounds, indicator posts and markers materials, abbreviations and colours shall be in accordance with standard drawing *EN7907*.

Covers and surrounds shall be capable of supporting load class D as defined by *AS 3996*. Covers shall be cast iron with a concrete surround. Covers and surrounds shall be provided to all hydrants and valves, regardless of installation location.

4.6.9 Water Pipe Bedding/Backfill Material

All water pipe bedding/backfill material shall be a washed sand/aggregate material, free of organic matter that complies with the particle size distribution in Table 8.1.

TABLE 8.1 – Sand/Aggregate for Water Pipe Bedding/Backfill Material Particle Size Distribution

AS Sieve Size (mm)	Percentage Passing by Mass
9.5	100
6.73	70 – 100
4.75	50 – 100
2.36	40 – 100
1.18	30 – 65
0.6	12 – 40
0.30	0 – 16
0.15	0 – 4
0.075	0 – 3

4.6.10 Warning Tape

All water mains shall be installed with detectable underground warning tape in accordance with *AS 2648 – Underground marking tape* and *Section 1 – General, Clause 27*.

4.7 SERVICE CONNECTIONS

Separate metered water services shall be provided to every allotment, all open space areas and

landscaped road areas including roundabouts and medians.

The meter box for each lot shall be located approximately 500mm inside the front and side property boundaries. Services shall be in pairs at side property boundaries. Note that the stop valve shall be located no more than 450mm inside the property, measured from the road alignment.

Meters are generally installed by Council upon receipt of a Development Application for construction on each individual lot.

All copper service connections shall cross the road perpendicular to the road centreline and be located within a 50mm diameter Class 12 PVC-U conduit sleeve. Such connections shall be marked on each kerb with a “W”.

4.8 ROAD CROSSINGS

Trenches through existing roads where required shall be backfilled using a 27:1 sand:cement mixture as per standard drawing *EN7901*. Road crossings shall be constructed perpendicular to the road centreline.

4.9 PIPE FITTINGS

Fire hydrants of an approved type shall be installed along the water main at maximum spacings of 90m. Hydrants shall also be provided at dead ends and all high points. Commercial and industrial areas shall have a maximum spacing of 60m.

Scour valves shall be provided at all low points and shall be discharged via a pipe to the stormwater system.

Stop valves are generally located adjacent to tees, and so that no more than 25 properties are isolated at any one time, by closing no more than four valves. Valve spindle extensions shall be fixed to prevent removal.

All maincocks, tees, hydrants, stop valves, scour valves, and air valves shall be located within the public verge.

At road intersections, two forty-five-degree (45^{o}) bends shall be used to negotiate the corner.

Thrust blocks shall be provided at all bends, tees, and dead ends, in accordance with standard drawing *EN7905*.

All valves and hydrants shall be enclosed within valve chambers in accordance standard drawing *EN7903*.

Markings and indicator posts shall be provided at all hydrants and valves in accordance with standard drawing *EN7907*.

4.10 TESTING

Prior to acceptance of the water reticulation network, all pipelines shall be inspected and tested in accordance with *Clause 6* of this Section.

4.11 TELEMETRY

Council operate a telemetry system to monitor the status and permit the remote control of strategic water and sewerage equipment.

Developers are required to carry out or fund the incorporation of new system components, such

as flow meters, valves, and pumps into Council's current telemetry system. All such work shall be conducted by an electrician or Contractor approved by Councils engineer.

4.12 CONNECTION TO EXISTING MAINS

Where it is necessary to connect to, tap into, or relocate an existing water supply main, this work shall only be done under supervision by Council and be carried out at the Developer's expense.

The Developer shall lodge payment for the work in advance and give 14 days' notice of when connection is desired.

All pipes and fittings required to complete the connection or tapping shall be provided by the Developer.

4.13 MAINS IN CUL-DE-SACS

Where the cul-de-sac incorporates an adjacent street connected by a concrete path, or ends in a public reserve, the water main shall extend through the pathway or reserve so that a dead-end is not created in the main.

In all other cases, the main is to be looped around the cul-de-sac in accordance with standard drawing *EN7908*.

4.14 ZONE OF INFLUENCE DESIGN FOR WATER MAINS AND SERVICES

All water mains and services shall be designed with the zone of influence from any adjacent structures considered in accordance with *Section 1 – General, Clause 26*. Zone of influence plans shall be provided where required.

5. WATER CONSTRUCTION GENERAL

5.1 EARTHWORKS AND BACKFILLING

5.1.1 General

Generally, earthworks shall comply with *Section 5 - Earthworks*.

5.1.2 Water Trench Excavation and Backfill

Water trenches shall be excavated in accordance with standard drawing *EN7904*. The Developer shall further excavate, where necessary, to allow the pipes to be properly handled, jointed, packed and to permit the free use of caulking tools and to facilitate backfilling around the pipe. The bottom of the trench shall be neatly trimmed to give the pipes a uniform bearing for the whole of the length of each pipe and allow the placing and compaction of not less than 100mm of approved bedding material as per the standard drawing listed above.

Water trenches shall be backfilled with materials as specified in the standard drawing *EN7904*, in layers not exceeding 200mm uncompacted thickness with a vibrating plate or other approved method. This includes backfilling with approved stabilised sand (sand:cement mixed at 27:1) batched and delivered by an approved concrete plant under all existing roadways.

5.1.3 Unsuitable Bedding Subgrade Material

Where the subgrade excavation level consists of material which, when compacted at optimum moisture content, would be of insufficient bearing value, or for any other reason, as deemed by Council's Engineer which constitutes unsuitable subgrade material, the Developer shall excavate to such further depth as directed by Council's Engineer, backfill with an approved suitable material and provide a subgrade of acceptable bearing capacity.

Unsuitable material shall be replaced with granular or other approved fill material placed in

layers not exceeding 200mm uncompacted thickness and compacted to 98% of the standard maximum dry density, when tested in accordance with *AS 1289*.

5.2 PIPES

5.2.1 Handling

The methods used for handling, laying and stacking pipes, fittings, valves and other materials shall be such as to avoid damage to the pipes, pipe coating and lining, and to other material, and shall comply with any recommendations made by the manufacturer. Cranes, skids or other approved devices shall be provided and used to ensure that pipes are not dropped or bumped during loading, cartage, unloading or when being placed in the trench. Pipes shall not be lifted or suspended from hooks, lifting dogs, or other devices placed at their ends.

5.2.2 Bedding

Bedding material shall comply with *Clause 4.6.9* of this Section. The material shall be compacted to the bottom of the trench at the correct level for pipe laying.

“Bell-Holes” shall be excavated under each joint. Care shall be exercised that the pipes are evenly bedded and supported along the length of barrel of the pipe and that a 20mm clearance is maintained between the underside of the pipe collar and the bottom of the “Bell-Hole”. Under no circumstances are pipes to be laid on their collars. After the pipe has been bedded to approval and the joint has been made, the recess under the bell shall be refilled with bedding material.

5.2.3 Pipe Laying

The methods used for pipe laying, jointing and installation of fittings shall conform to manufacturers specifications, particularly with respect to depth of entry of spigot ends. All cut ends of pipes shall be properly chamfered before joints are made.

The pipes shall be laid and jointed accurately to lines, gradients and levels shown in the approved drawings. All pipes shall be laid in such a manner that pipe barrels have solid bearing throughout their length.

Before pipes are laid, all dirt and foreign material that may have entered the pipes or fittings shall be removed and the outside of spigots and inside of sockets and flanges thoroughly cleaned of foreign matter.

Unless otherwise directed or approved by Council’s Engineer, pipes shall be laid on continuously rising grades from scour valve to air valve, notwithstanding any minor irregularities in the ground surface. This provision is not applicable in a reticulation system.

Where two or more lines of pipe shall be laid side by side, the space between the lines of pipe shall be of a width of 300mm, unless otherwise specified or shown on the approved drawings.

All open ends of pipeline stubs shall be blanked and closed off before backfilling commences.

5.2.4 Jointing

5.2.4.1 Spigot and Socket Joints

DICL spigot and socket joints shall be “TYTON” patented slip-on type rubber gasket joints. Pipes shall be installed in accordance with the manufacturer’s specifications, and the following additional requirements:

- Only lubricant recommended by the manufacturer shall be used. Oil and grease shall not

be used as lubricant.

- The edges of cut pipes shall be rounded off or provided with a chamfer to avoid damage to the rubber gasket when making the joint.
- Each pipe shall be pushed into the socket to the correct depth, which is generally indicated by a painted stripe on the barrel at the spigot end. In the case of cut pipes or any other pipes which are not provided with painted stripes, a clearance of approximately 6mm shall be left between the spigot end of each such pipe and the bottom of the socket of the adjacent pipe or fitting. Cut pipes shall be marked prior to jointing to ensure that this clearance is achieved.

5.2.4.2 Flanged Joints

All flanged joints shall be installed in accordance with the manufacturer's specifications and the following additional requirements:

- Flanged joints shall be carefully made with elastomeric gaskets provided by the manufacturer and the nuts shall be uniformly tightened.
- Gaskets, which cover only the flange face within the bolt holes, shall be fixed in position to one of the flanges with an approved adhesive. The Developer shall ensure that the bore of the flange is not obstructed by incorrect location of the elastomeric gasket.

5.2.4.3 Gibault Joints

Gibault joints are only to be installed when approved in writing by Council's Engineer. Generally, gibault joints will not be allowed for new works. Gibault joints shall be installed in accordance with the manufacturer's specifications and approximately 6mm clearance shall be left at the centre of the sleeve between the ends of the pipes and/or fittings jointed.

5.2.5 Restraining/Anchoring

Valves, flexibly jointed bends, tees and other points in the pipeline where there are unbalanced forces shall be adequately restrained to withstand the forces resulting from an internal pressure of 1.2MPa when the pipeline is under test by packing between the fitting and the side of the trench with concrete in accordance with standard drawing *EN7905* or as approved by Council's Engineer provided that, notwithstanding any such approval, the Developer shall be responsible for any failure of the pipeline that may be due to inadequate restraint.

Steeply inclined pipelines with flexible joints shall be secured in accordance with Table 8.2 below and standard drawing *EN7895*. Unless otherwise specified or directed by Council's Engineer, where the pipe joints are not designed to withstand longitudinal forces, the concrete bulkheads shall be spaced in accordance with Table 8.2.

TABLE 8.2 – Water Pipe Anchoring Measures

Gradient	Anchoring Measures and Maximum Spacing (m)
Less than 6.5%	No anchoring required
6.5% to 10%	Trench stop (1) every third collar
10% to 15%	Concrete bulkheads (2) spaced no greater than 100 divided by the pipe gradient expressed as a %. Example for pipe on 12.5% grade: 100 ÷ 12.5% = 8m spacings
15% to 25%	Concrete bulkheads (2) spaced no greater than 100 divided by the pipe gradient expressed as a % multiplied by 2. Example for pipe on 20% grade: 100 ÷ (20%x2) = 2.5m spacings
Greater than 25%	Not permitted

(1) – trench stops shall be polyethylene bags with a minimum thickness of 0.25mm filled with clay or other approved material, sealed in an approved manner, placed under, around and to 300mm above the pipe at every third collar. Bags shall not be placed on sand bedding.
(2) – concrete bulkheads shall be constructed in accordance with standard drawing *EN7895*.

5.2.6 Polyethylene Sleeving

Wherever so specified, the Developer shall encase a pipeline, or part thereof, in polyethylene sleeving. Such sleeving shall be provided in addition to, but not as substitute for, any corrosion protection otherwise specified.

Application of the polyethylene sleeving and adhesive tape shall be in accordance with the manufacturer's specifications, and the Developer shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving, overlapped for a minimum of 250mm at each field position with at least 3 circumstantial turns of adhesive tape. As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately one metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. Valves, hydrants and irregular shaped fittings shall be hand wrapped using flat polyethylene sheets and securing these with plastic adhesive tape to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of tubing.

Any damage made to the polyethylene sleeving before or after backfilling of the trench shall be made good by the Developer to the satisfaction of Council's Engineer.

5.3 CORROSION PROTECTION OF STEEL BOLTS AND NUTS

All steel bolts and nuts used for installation below ground shall be thoroughly coated, after the nuts have been tightened, with an approved corrosion protecting material, which is acceptable to Council's Engineer. Bolts and nuts shall be dry, clean and free from rust immediately before application of the coating. Stainless steel bolts and nuts need not be coated.

5.4 ROAD CROSSINGS

Road crossings (for all services/utilities) shall be completed prior to compaction of pavement subgrade.

Services shall be laid perpendicular to the centreline of the roadway. Pipes/conduits shall extend a minimum of 450mm into the verge measured from the top of kerb.

Trenches shall be backfilled in accordance with *Clause 5.1.2* of this Section.

Where water services and pipe/conduits cross the road, the kerb shall be marked with a chiselled "W" directly above the service pipe/conduit.

5.5 SERVICES

All water services shall be constructed in accordance with standard drawing *EN7906*. Water services shall be subject to testing and disinfection as per mains.

Where service connections are to be made to a main pipeline, tapping bands shall be used and installed in accordance with *AS 4793*.

5.6 DRAINAGE/SCOUR LINES

Drainage lines associated with water supply pipelines include drainage lines from scour valves, valve chambers or other structures.

Pipes and fittings, which are used in the construction of drainage lines, shall be provided with flexible joints, such as rubber ring joints. Unless otherwise directed by Council's Engineer, the Developer shall bed, lay and joint these in accordance with this Section.

Drainage lines from scour valves shall be tested by opening each scour valve, fully or partially, as directed by Council's Engineer, while the pipeline is under full static head. Any damage to a scour line which may result from such testing shall be made good by the Developer at their own expense.

5.7 CONNECTIONS

Connection to existing water mains shall only be made under supervision by Council and Council's Engineer and no connection will be approved and allowed until all new mains have been flushed and disinfected (and these items approved) to prevent entry of silt and foreign objects into Council's water reticulation system.

5.8 MARKERS

Opposite each valve, scour valve, air valve and hydrant the Developer shall fix a marking plate in a manner and position in accordance with standard drawing *EN7907* and as approved by Council's Engineer.

Where, in the opinion of Council's Engineer, a valve or hydrant is at too great a distance from any existing kerb and guttering to which the marker plate can be fixed, the Developer shall provide and set firmly in the ground a wooden post and shall fix the relevant marker plate with four galvanised screws or clout nails at the top of the post, facing the valve or hydrant. The distance to the valve or hydrant in metres, to an accuracy of 0.1m shall be permanently die-stamped on the marking plate with numbers 10mm high.

The wooden indicator post shall be 90mm x 90mm hardwood. When installed, the post shall project 1m above the ground, or where tall grass or crops are likely to obscure the post, and where directed by Council's Engineer, its height above the ground shall be increased to 1.5m.

Where soft ground is encountered, the post shall be driven into the ground to a minimum depth of:

- 600mm for posts projecting 1m above the ground.
- 900mm for posts projecting 1.5m above the ground.

Where rock or hard ground is encountered, the post shall be potted to a minimum depth of 300mm in rock and 500mm in hard ground where the post cannot be driven in, irrespective of the height of the post above the ground surface.

Before a post is installed, it shall receive 2 coats of bituminous paint, on all surfaces from the bottom of the post to a point, which would be approximately 200mm above the ground when the post is installed. The remainder of the post shall receive 1 coat of wood primer and 2 coats of white enamel for exterior use. All these materials shall be supplied by the Developer and shall be subject to approval by Council's Engineer.

Marker plates shall be fixed as soon as practicable after each valve or hydrant is installed. However, marker plates for hydrants shall be temporarily covered using masking tape or other approved cover to prevent accidental usage, which shall be removed by the Developer on satisfactory completion of testing of the pipeline.

Where permanent marking of a pipeline (other than reticulation) is specified, the above provisions shall apply, together with the following additional requirements:

- Marking plates bearing the words “WATERMAIN” shall be fixed along the pipeline route at all points of change of direction and, unless otherwise directed by Council’s Engineer, at intervals of approximately 100m from each other and from other marking plates. The location of such marking plates may be varied by Council’s Engineer, having regard to the proximity of valves, hydrants, bends, fences crossing the pipeline and to the nature of the terrain.
- The distance from the marking plate to the centreline of the pipeline in metres, to an accuracy of 0.1m, shall be permanently die-stamped on the marking plate with numbers 10mm high.
- Where marking plate bearing the words “WATERMAIN” shall be fixed on a wooden post, such post, and its installation shall conform to the provisions in this Clause.

5.9 OBSTRUCTIONS

If required by Council’s Engineer, the Developer shall provide everything necessary to determine that no obstructions exist in the pipeline, including camera footage of the line. Any obstruction shall be removed to the satisfaction of Council’s Engineer.

6. TESTING & SURVEY REQUIREMENTS

Where testing and survey items are specified by Consent Conditions or Council’s engineer, the Developer shall arrange for the testing to be undertaken. Testing shall be treated as a hold point in the development and subsequent works shall not proceed until approval has been given.

Where specified, tests shall be undertaken in accordance with Australian Standards by a NATA approved testing laboratory. All test results from the NATA approved testing laboratory shall be filed and provided to Council, regardless of the results of the testing.

6.1 MATERIALS

All materials shall be proven to be compliant with the requirements of this Section by provision of material specifications and/or NATA laboratory testing.

6.2 TESTS & SURVEY

- Water pipe bedding/backfill material testing to confirm compliance with Clause *4.6.9* of this Section by NATA laboratory.
- Trench backfill supervision by Level 1 GITA or SMDD testing by Level 2 GTA or NATA laboratory.
- Pressure testing in accordance *Clause 6.2.1* of this Section by NATA laboratory.
- Disinfection testing in accordance with *Clause 6.2.2* of this Section by NATA laboratory.
- Survey during construction works.
- Works as executed survey by registered surveyor.

6.2.1 Pressure Testing

Pipelines shall be tested in sections as soon as practicable after each section has been laid and jointed, in accordance with the following:

- All pipe joints shall be left uncovered until the whole of the section has been successfully pressure tested.
- The pressure testing shall not be commenced earlier than four days after the last concrete thrust or anchor block in the section has been cast.
- A section shall be defined as a length of pipeline which can be effectively isolated for testing, e.g. by means of main stop valves.

- Pressure testing shall not be carried out during wet weather.
- During pressure testing all joints shall be clean, dry and accessible for inspection; each stop valve shall sustain at least once the full test pressure on one side of the valve with no pressure on the other side for at least 15 minutes.
- To achieve conditions as stable as possible for testing by allowing for absorption, movement of the pipeline and escape of entrapped air, the section shall be kept full of water for a period of not less than 24 hours prior to the commencement of the pressure testing.
- A hydrostatic test pressure of 1.2MPa shall be applied to each section of the pipeline such that at each point of the section the test head shall be equal to or greater than 1.2MPa but shall not exceed 1.5MPa.
- The hydrostatic test pressure shall be maintained if required by the inspector while the whole of the section is examined, and in any case, not less than 8 hours. To determine the actual leakage losses, the quantity of water added to maintain the pressure during the period of testing shall be carefully measured and recorded.

The pressure testing of a section shall be satisfactory if:

- There is no failure of any thrust block, anchor block, pipe, fitting, valve, joint or any other pipeline component.
- There is no visible leakage.
- The measured leakage rate does not exceed the permissible leakage rate as determined by the following formula:

  QDI = 0.0105 x D x L (H) ½

Where:

QDI = permissible leakage rate (litres per hour) for DICL

D = nominal diameter of pipe (mm)

L = length of section tested (km)

H = average test head (m)

Any failure, defect, visible leakage and/or excessive leakage rate, which is detected during the pressure testing of the pipeline or during the Defects Liability Period, including any failure of thrust blocks or anchor blocks, shall be rectified by the Developer at their own expense.

The Developer shall provide all material, labour and equipment required for the pressure testing, including approved pumps and pressure gauges.

All repairs necessary are at the Developers cost, and the method of repair is subject to Council's Engineers approval and inspection.

Pressure testing of new mains shall be supervised by a Council representative. New mains shall be disinfected in accordance with *Clause 6.2.2* of this Section.

All mains shall remain under reticulation pressure for the full length of the Defects Liability Period.

6.2.2 Disinfection Procedure and Testing

6.2.2.1 Purpose

This procedure describes measures which must be undertaken to disinfect new filtered water

mains 150mm in diameter and larger. These requirements must be met to minimise contamination risks and ensure water in new mains meets the *Australian Drinking Water Guidelines*. This procedure applies to all new water mains before they are connected to the filtered water reticulation network. At Council's discretion, the requirement to apply these guidelines to smaller sized mains may be varied.

For mains smaller than 150mm in diameter, flushing shall be undertaken until a free chlorine residual of at least 0.2mg/L is confirmed. A Council representative shall be present to confirm the result. Council approval must be received in writing before the main is put into service.

6.2.2.2 Contamination Prevention

The risks of contamination must be reduced by preventing contaminated materials from entering the water main during storage, construction and maintenance. Particulate matter may contain bacteria and prevent chlorine solution from effectively contacting and eradicating such organisms.

6.2.2.3 Procedure

1. Continuous Feed Chlorination

- Thoroughly flush and clean all pipework and fittings.
- Fill the main with water from a connection to the existing drinking water distribution system. At the point where the potable water enters the main, dose sodium hypochlorite (12.5%) at a constant rate, such that the water will have a free chlorine residual of not less than 20mg/L and no more than 40mg/L. The application of chlorine shall not cease until the entire water main is filled with superchlorinated water.
- Undertake a chlorine test to confirm initial chlorine concentration (shall be 20 – 25mg/L). Take a photo of the results for Council report (Step 3).
- Allow the main to sit with the superchlorinated water for 24 hours contact time.
- After 24 Hours, undertake another chlorine test. A minimum of 10mg/L chlorine must be achieved. If the test does not achieve this minimum chlorine level, repeat another cycle of chlorination.

2. Disposal of Superchlorinated Water

- Once the chlorine requirements are met (or if a second chlorination cycle is required), carefully prepare to discharge the water. Chlorinated water must not be disposed directly into sewer, stormwater or the natural environment. Dechlorination may be undertaken using neutralising agents or by water capture, containment and allowing time for chlorine dissipation. Chlorine testing shall be undertaken to ensure chlorine levels of discharged water are:
  - Less than 1.0mg/L prior to disposal onto low risk grassed areas, or
  - Less than 0.1mg/L prior to disposal near waterways, creeks or drains.
- Water must be flushed from the main until the chlorine residual is no higher than that generally prevailing in the distribution system (approximately 1.5mg/L).

3. Refilling the Main and Water Quality Testing

- Refill the main with water from the existing drinking water distribution system.
- Contact Council to arrange a time for water quality sampling. Council staff will sample from location/s as confirmed by Council. Where single mains have been disinfected, the sample location will be located centrally where possible. Where a larger system with multiple distribution mains has been disinfected, additional sample points will be required and confirmed by Council.

- Council will undertake the sampling in accordance with NSW Health drinking water sampling procedures. Sample/s will be sent to a NATA certified laboratory to ensure the water complies with the parameters in Table 8.3.

TABLE 8.3 – Water Quality Parameter Limits

Parameter	Unit	Acceptance Range
pH	-	6.8 - 8.5 (1)
Turbidity	NTU	Less than 5
True colour	HU	≤ 15
Chlorine (free)	mg/L	0.2 – 3.5
Total coliform count	cfu/100ml	0
Faecal coliform count of E.coli count	cfu/100ml	0
Heterotrophic plate count	cfu/ml	0 – 10

(1) – An upper limit of 9.2 is acceptable if all other results are meet specifications and the main will be put into use immediately.

- Council will provide the sample results in writing to the Developer once received from the NATA laboratory. A turn-around time of approximately one week will be required to receive the results.
- Where all test results comply with the above standards, Council will provide written approval to commission the main.
- Where test results do not comply with the above standards, further mains cleaning works shall be undertaken by the Developer before re-sampling and re-testing. Council will undertake repeat sampling at additional cost (refer to current Revenue Policy).
- The water main must remain isolated from the Bathurst water distribution network until compliant results are received and written approval to commission the main is provided by Council.

6.2.2.4 Chemical Use

Chlorine disinfectants and neutralising agents must be used in accordance with the material Safety Data Sheet. Any chemicals or materials for use in contact with the drinking water must meet the requirements of *AS 4020*.

6.3 TESTING & SURVEY SPECIFICATIONS

All items listed in *Clause 6.2* of this Section shall comply with the requirements of this Clause. Tables 8.4 to 8.7 detail the required test types, results, tolerances and frequencies of testing.

TABLE 8.4 – Required Tests and Survey Description

Item	Required Tests and Survey Description
Water pipe bedding/backfill material	• Particle size distribution test in accordance with *AS 1289*.
Trench backfill	• SMDD compaction test to *AS 1289*.
Pressure Testing	• Pressure test in accordance with *Clause 6.2.1* of this Section.
Disinfection Testing	• Disinfection testing in accordance with *Clause 6.2.2* of this Section.
Survey during works	• All installed water pipes (including services) shall be surveyed at top of pipe level at intervals not exceeding 40m prior to backfill. • All installed valves, hydrants, bends, tees, fittings, and changes in grade shall be surveyed at top of pipe level prior to backfill. • All anchor/thrust blocks and concrete bulkheads shall be surveyed at finished level to show full extent of structure prior to backfill.
Works as executed survey	• All installed water valve, hydrant and meter covers shall be surveyed. • All markers shall be surveyed at finished ground level. • All drainage line outlets shall be surveyed at invert level.

TABLE 8.5 – Required Results

Item	Required Results
Water pipe bedding/backfill material (1)	• Particle size distribution to comply with *Clause 4.6.9* of this Section.
Trench backfill (2)	• SMDD shall be 98% at ± 2% optimum moisture content.
Pressure Testing (3)	• All parameters detailed in *Clause 6.2.1* of this Section shall be met.
Disinfection Testing (3)	• All parameters detailed in *Clause 6.2.2* of this Section shall be met.
Survey during works (4)	• Water pipes intermediate levels shall target design. • Water pipes and fittings intermediate alignments shall target design.

(1) – if material does not meet the requirements, an alternate material shall be sourced.

(2) – failure to achieve any of the required results means non-compliance for the trench, 50m in each direction of the failed test or between the two service pits.

(3) – failure to achieve any of the required results will result in non-compliance.

(4) – see Table 8.6 for tolerances.

TABLE 8.6 – Water Pipe Level and Alignment Tolerances

Item	Tolerance
Pipe intermediate levels	No more than 30% of survey points to be outside of ± 60mm of design
Pipe intermediate alignments	No more than 20% of all survey points to be outside of ± 50mm of design

TABLE 8.7 – Required Test Frequencies for NATA Laboratory Works

Item	Required Frequency
Water pipe bedding/backfill material	• One test and inspection every 250m^3.
Trench backfill	• SMDD tests shall be undertaken for every second layer with the following requirements: o One test every 40m of trenching, including at least one test between all service pits/changes in direction. o For each played layer, the testing location will be randomly changed from the location of the test on the previous layer.

SECTION 9 - SEWERAGE INFRASTRUCTURE

1. INTRODUCTION

This Section of the Guidelines for Engineering Works outlines Council's requirements for the design and construction of sewerage infrastructure. It shall be read in conjunction with the relevant Water Service Association of Australia (WSAA) publications, Public Works Advisory NSW standards and manufacturers recommended procedures.

2. STANDARDS AND REFERENCES

Unless otherwise specified or approved, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standards listed in this Section.

Standards relevant to this Section include, but are not limited to:

- *AS 1141 – Methods for sampling and testing aggregates*
- *AS 1260 – PVC-U pipes and fittings for drain, waste and vent applications*
- *AS 1281 – Cement mortar lining of steel pipes and fittings*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 1316 – Masonry cement*
- *AS 2032 – Installation of PVC pipe systems*
- *AS 2280 – Ductile iron pressure pipes and fittings*
- *AS 2566 – Buried flexible pipelines*
- *AS 2648 – Underground marking tape*
- *AS 3500 – Plumbing and Drainage*
- *AS 3680 – Polyethylene sleeving for ductile iron piping*
- *AS 3681 – Application of polyethylene sleeving for ductile iron piping*
- *AS 3850 – Prefabricated concrete elements*
- *AS 3996 – Access Covers and Grates*
- *AS 4041 – Pressure piping*
- *AS 4058 – Precast concrete pipes (pressure and non-pressure)*
- *AS 4198 – Precast concrete access chambers for sewerage applications*
- *AS 4680 – Hot-dip galvanised (zinc) coatings on fabricated ferrous articles*
- *Water Services Association of Australia – Pressure Sewerage Code of Australia*
- *Water Services Association of Australia – Vacuum Sewerage Code of Australia*
- *Water Services Association of Australia – Gravity Sewerage Code of Australia*
- *Water Services Association of Australia – Sewage Pumping Station Code of Australia*

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN7883 – Trench Shielding Requirements*
- *EN7885 – Urban Road Verge Allocations Pre-September 2023*
- *EN7895 – Pipe Restraint & Concrete Bulkhead Details*
- *EN7898 – Sewer Manhole Details*
- *EN7900 – Sewer Junction Details*

- *EN7901 – Sewer Pipe Bedding & Backfill Details*
- *EN7902 – Zone of Influence Diagram and Pipe Concrete Encasement Details*
- *EN11576 – Sewer Main Encasement for Junction Cut-In Work Details*
- *EN12046 – Urban Road Typical Layout & Verge Details in Greenfield Sites from 21 September 2023*

3. ENGINEERING DRAWINGS

Engineering drawing submissions shall include all information requested in *Section 1 – General*, *Clause 5* and detail all works necessary to extend sewerage such that each allotment and public reserve lot includes a junction located entirely within the property boundary.

3.1 PLAN

Sewer plans shall be drawn at a standard scale not greater than 1:500 sufficient to show all necessary details. The following information shall be included:

- Boundaries of allotments, roads, paths, easements, and reserves.
- Allotment numbers.
- Street name.
- Location of sewerage and all sidelines, dead ends, junctions and manholes.
- Tabulated distances from downstream manholes to proposed junctions.
- Discrete sewer main and manhole numbers.
- Natural surface contours and proposed ground surface levels (if different).
- Existing sewerage, and all other utility service lines crossing the main.
- Pipe class, diameter and material.
- North point and bar scale.

3.2 LONGITUDINAL SECTIONS

Longitudinal sections along the centreline of all sewer mains at standard scale not exceeding 1:500 horizontally with a vertical exaggeration of 2 or 5. The following details shall be included on longitudinal sections for each main:

- Invert, natural surface, and proposed ground surface levels.
- Depth from invert to proposed ground surface level.
- Chainage along pipe.
- Pipe gradient, class, diameter, and material.
- Sewer main and manhole numbers.
- Depth and size of utility services which cross the main, and vertical clearance to pipes.
- All length measurements shall be in shown in metres. Distances shall be measured to two decimal places (e.g. 77.24m), and levels shown to the Australian Height Datum to three decimal places (e.g. 687.813m). Grades shall be shown as percentage figures to three decimal places (e.g. 1.285%).

3.3 RISING MAINS AND STRUCTURES

Detailed engineering drawings and supporting information will be required for any rising mains and structures such as pumping stations and specialised manholes proposed for construction with the sewerage works.

3.4 SUPPORTING INFORMATION

Calculations detailing anticipated pipe loadings, velocities and flow rates, and pumping station data (where necessary) shall be submitted for approval with the engineering drawings.

Where commercially available software packages are used to design sewer systems, a copy of all data files shall be provided to the Council prior to approval being granted. Note that the use of software does not negate the designer of their responsibility in ensuring an appropriate design which meets the requirements of these Guidelines.

4. DESIGN REQUIREMENTS

Council requires that all allotments be provided with a sewer junction, located so that 90% of the property can be sewered.

4.1 DESIGN FLOWS

Design sewer flows shall be calculated in accordance with the relevant Water Service Association of Australia (WSAA) publications and/or Public Works Advisory NSW standards.

4.2 COMPONENT DESIGN

Components of the sewerage system shall be designed in accordance with the relevant Water Service Association of Australia (WSAA) publications and/or Public Works Advisory NSW standards.

4.3 PUMPING STATIONS

Early stage designs for sewerage pumping stations (SPS) shall be submitted to Council for detailed review and comments. The following list details the minimum requirements/ considerations that shall be detailed for all proposed SPS:

- Wet well capacity shall be sufficient for the total ultimate peak wet weather flow (PWWF).
- Pumps shall be sized for a maximum 8 starts per hour and provide a self-cleansing velocity of 0.6m/s in the rising main.
- SPS shall be designed to limit retention time and hydrogen sulphide build up. Offline storage shall be incorporated in design and be capable of storing a minimum of 8 hours average dry weather flow in case of electrical or mechanical breakdown.
- Minimum volume from top water level to bottom water level is to be the volume pumped in 90 seconds.
- Full stand-by pump capacity is required, with the pumps on an automatic changeover from duty to standby. There shall be at least a 4-hour retention time within the sewer reticulation system before any surcharges.
- SPS shall be located entirely within the boundaries of a parcel of land (including all associated pipe work, electrical and telemetric cabling, access roadways and maneuvering areas, dry water storage tank, etc.) dedicated only to Council under a separate title. The surface level of any pumping station allotment shall be a minimum of 500mm above the 1% AEP flood level of any water course or drainage reserve. The allotment shall have direct access from a Local Access, Collector or Distributor Road.
- Duty and standby pumps shall be sized to suit the ultimate capacity of the proposed development. Variable speed drives for pump motors to be included.
- All internal pipework shall be ductile iron cement lined (with sulphate resistant cement lining) with exterior coating resistant to hydrogen sulphide attack.
- All wet wells and any other exposed concrete shall be covered with a two-pack epoxy liner or equivalent.

- Electromagnetic flow meter in separate pit on the outlet shall be connected to Councils telemetry system.
- Alarms to notify SPS operator of high level, overflow and pump failure (at a minimum). A visible flashing light on the exterior of the SPS infrastructure shall be included as a visible alarm. Alarms shall be connected to Councils telemetry system.
- Storage well shall be constructed from sulphide resistant cement (if concrete) or similar approved material to resist sulphide attack.
- Internal fittings shall be Grade 316 Stainless Steel (guide rails, lifting devices for pump etc.).
- Lids shall be lockable with internal safety mesh.
- Suitable anchor points for working at heights shall be incorporated in the roof well or structure to enable safe maintenance and cleaning.
- Water connection with testable backflow prevention shall be provided to well for maintenance. Shall be separately metered with a 25mm service connection.
- SPS lids shall be a minimum of 500mm above 1% AEP flood level.
- Switchboard base shall be a minimum of 500mm above 1% AEP flood level. Switchboard shall include space for or include telemetry for Councils network.
- Switchboard shall have a stainless-steel cabinet, interior light and be covered for access during wet weather.
- Exterior lighting for emergency night work shall be provided.
- Separate electrical meter shall be provided and registered to Council.
- Electrical ducts to switchboard shall be sealed against gas attack.
- Approved odour control to be incorporated into well design.
- Concrete or asphalt access a minimum of 5m wide shall be provided to SPS.
- Pump station, off-line storage well and switchboard shall be fenced with man-proof fencing and shall include a double access gate for maintenance vehicle and a personal access gate.
- Valves may be required on the inlet and/or outlet pipework.
- Sewer rising main shall be located on Council land or within a dedicated easement.

4.4 EASEMENTS

Where any service is not located on a public road, easements shall be required in accordance with Tables 9.1 and 9.2 below:

Table 9.1 – Gravity Main Easement Widths

Pipe Size	Minimum Easement Width (metres)
Less than 300mm diameter	Easement not required
300mm diameter or greater	5.0

Table 9.2 – Rising Main Easement Widths

Pipe Size	Minimum Easement Width (metres)
150mm diameter	3.0
225mm diameter	4.5
300mm diameter or greater	5.0

4.5 TELEMETRY

Council operates a telemetry system to monitor the status and permit the remote control of strategic water and sewerage equipment.

Developers are required to carry out or fund the incorporation of new system components, such as flow meters, valves, and pumps into Council's current telemetry system. All such work shall be conducted by an electrician or Contractor approved by Councils engineer.

4.6 RISING MAINS

4.6.1 Design Guidelines

Minimum pipe diameter shall be 100mm, and shall be capable of withstanding maximum working head, including an allowance for water hammer and creep.

Velocity in the rising main shall be a minimum of 0.6m/s and shall not exceed 3.0m/s.

4.6.2 General Requirements

Each pump discharge line is to be provided with a reflux valve and stop valve, with the stop valve located upstream of the reflux valve.

An approved air valve is required at high points in the main.

A scour valve and line are required to enable the rising main to be completely drained of sewage. The receiving manhole shall be vented.

Rising mains from pumping stations shall be constructed from ductile iron (bitumen coated) rubber ring jointed pipe to the requirements of *AS 2280*. Alternative pipe materials may be considered for some sites.

A flow meter shall be incorporated in the rising main immediately downstream of the pumping station.

4.6.3 Cover and Clearance

Minimum cover to a ductile iron rising main shall be an absolute minimum 500mm or in accordance with manufacturers requirements where the manufacturer specifies a cover greater than 500mm based on the application and site conditions. For any approved material other than ductile iron, Council's Water and Waste Section must be consulted for minimum cover.

No services shall be laid in parallel to a rising main within the zone of influence. A minimum clearance of 500mm shall be maintained surrounding the outer face of a rising main including any service crossing above or below the rising main.

4.6.2 Materials

4.6.2.1 Spigot and Socket Main

Spigot and socket mains shall be rubber ring jointed ductile iron concrete lined pipe in accordance with *AS 2280* with the following additional requirements as a minimum:

- Shall be the following classes based on diameter:
  - Up to 300mm diameter – Class PN20.
  - 300mm diameter or greater – Class PN35.
- The socket shall be patented "TYTON" elastomeric seal spigot-socket joint.
- The spigot shall be provided with a chamfer in accordance with the manufacturer's specifications for the "TYTON" socket joint.
- Shall be "Tyton Xtreme" or approved equivalent sulphide resistant pipe with Calcium Aluminate Cement (CAC) lining.

4.6.2.2 Flanged Main

Flanged mains shall be ductile iron concrete lined (DICL) pipe in accordance with *AS 2280* with the following additional requirements as a minimum:

- Shall be the following classes based on diameter:
  - Up to 300mm diameter – Class PN20.
  - 300mm diameter or greater – Class PN35.
- Flanged joins shall be sealed with the manufacturers elastomeric gasket and tightened to the specified torque.
- Shall be "Tyton Xtreme" or approved equivalent sulphide resistant pipe with Calcium Aluminate Cement (CAC) lining.

4.6.2.3 Warning Tape

All sewer rising mains shall be installed with detectable underground warning tape in accordance with *AS 2648 – Underground marking tape* and *Section 1 – General, Clause 27*.

4.7 GRAVITY MAINS

4.7.1 Location and Clearance

Sewer gravity mains shall generally be positioned so they run parallel to the lowest boundary of allotments, and one metre from front, rear, or side boundaries. However, where interallotment drainage is also constructed, sewerage shall be located nearest the centre of the lot.

The minimum clearance between sewer mains and adjoining services shall be 400mm in the horizontal plane, and 150mm in the vertical direction (or 300mm for high voltage electrical cables/high pressure gad pipes).

The minimum clearance between sewer mains and adjoining structures is 1.2m for 150mm diameter mains, or 2m for mains of diameter 225mm or greater. This clearance is measured from the outside edge of the main to the nearest edge of the footing. Additional requirements may be imposed depending on whether easements exist.

Mains shall be extended to the extremities of the development to permit future extension without disturbing established areas.

4.7.2 Materials

4.7.2.1 Pipes

Generally, gravity sewer pipes laid shall be a minimum of Class SN8 rubber ring jointed PVC-U in accordance with *AS 1260*.

Council may also permit the use of Class PN20 DICL pipe in accordance with *AS 2280* to a minimum cover of 450mm and the following requirements:

- Shall be the following classes based on diameter:
  - Up to 300mm diameter – Class PN20.
  - 300mm diameter or greater – Class PN35.
- The jointing method for rubber ring jointed pipes shall be patented “TYTON” elastomeric seal spigot-socket joint.
- The jointing method for flanged jointed pipes shall be in accordance with manufacturers specifications using an elastomeric gasket tightened to the specified torque.
- Shall be “Tyton Xtreme” or approved equivalent sulphide resistant pipe with Calcium Aluminate Cement (CAC) lining.

The same type of pipe material is to be used for the full length between manholes.

For diameters greater than 375mm, in cases where the desired material conforming to the above specification is not available, Council’s Water and Waste Section must be consulted for alternatives.

4.7.2.2 Polyethylene Sleeving

In areas containing aggressive soils where DICL pipes shall be used, polyethylene sleeving shall be used and comply with the requirements of *AS 3680* and *AS 3681* and meet the following additional requirements:

- Be “Tyton Polyboss” or approved equivalent.
- Have a minimum thickness of 0.2mm.
- Have a minimum ultimate tensile strength of 50N.
- Have an impact resistance greater than 900g.
- Have tear resistance greater than 25N.
- Be cream in colour.
- Tape used on sleeving shall be PVC duct tape, be a minimum of 0.18mm thick, be a minimum of 50mm wide and shall not be black in colour.

4.7.2.3 Jointing Seals and Gaskets

All jointing seals to be supplied for use shall comply with *AS 1646*.

All flange insertion gaskets to be supplied with for use shall comply with *AS 4087*.

4.7.2.4 Manholes and Covers

All precast manhole components shall comply with *AS 4198* and standard drawing *EN7898.*

Cast insitu manhole bases shall be constructed in accordance with standard drawing *EN7898*, using concrete with a minimum strength of 25MPa.

Manholes shall be sealed using materials and methods approved by the Principal.

Covers shall be capable of supporting the following load classes defined by *AS 3996*:

- All non-trafficable areas – Class B.
- Any trafficable area – Class D.

4.7.2.5 Step Irons

Council discourages the use of step irons inside manholes. The Developer shall obtain approval from Council's engineer before installing step irons inside the manholes. However, if approved, all step irons are to be plastic encapsulated steel or grade 316/316L stainless steel.

4.7.2.6 Sewerage Pipe Bedding/Backfill Material

All sewerage trench material shall be a washed sand/aggregate material, free of organic matter that complies with the particle size distribution in Table 9.3 below.

TABLE 9.3 – Sand/Aggregate for Sewerage Pipe Bedding/Backfill Material

AS Sieve Size (mm)	Percentage Passing by Mass
9.5	100
6.73	70 – 100
4.75	50 – 100
2.36	40 – 100
1.18	30 – 65
0.6	12 – 40
0.30	0 – 16
0.15	0 – 4
0.075	0 – 3

4.7.2.7 Warning Tape

All sewer gravity mains shall be installed with detectable underground warning tape in accordance with *AS 2648 – Underground marking tape* and *Section 1 – General, Clause 27*.

4.7.3 Sizing

Sewer capacity shall 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).

Mains shall be sized to cater for PWWF and graded sufficient to achieve self-cleansing at PDWF.

The minimum pipe diameter shall be 150mm.

The Developer shall liaise with Council's Water and Wastewater section when mains exceed 225mm in diameter as special considerations apply.

4.7.4 Gradient

4.7.4.1 Minimum Grades

The minimum permissible grade of a sewer main is governed by the number of contributing Equivalent Tenements (ET), where each urban residential lot is equal to 1 ET. Where other types of development are contributing to the sewer main, Council's Water and Waste Section will

be able to assist with determination of the correct number of Equivalent Tenements.

Table 9.4 shall be used to determine the minimum grade of 150mm diameter sewer mains. Council's Water and Waste Section can provide advice on minimum sewer grades where larger diameter mains are required.

Table 9.4 – Minimum Sewer Grades for 150mm Diameter Mains

Minimum Sewer Grade		Minimum ET		Maximum ET
1 in x	%	Absolute	Normal	Normal
80	1.25	1	1	221
90	1.11	2	3	208
100	1.00	4	6	196
110	0.91	7	9	186
120	0.83	10	13	178
130	0.77	14	18	170
140	0.71	18	23	164
150	0.67	24	30	158
160	0.63	30	35	152
180	0.56	41	48	143
200	0.50	56	65	135

4.7.4.2 Maximum Grades

The maximum sewer grade may be governed by the need to service upstream properties. Special measures are required for sewer grades more than 6.5% to prevent scouring, as defined in *Clause 5.2.5* of this Section.

4.7.5 Cover

The minimum cover for gravity sewer pipes shall be:

- For 150mm pipes - an absolute minimum of 700mm or in accordance with manufacturers requirements where the manufacturer specifies a cover greater than 700mm based on the application and site conditions.
- For 225mm pipes - an absolute minimum of 900mm or in accordance with manufacturers requirements where the manufacturer specifies a cover greater than 900mm based on the application and site conditions.
- In exceptional circumstances and where ductile iron cement lined pipes are used (with prior written approval from Councils engineer) from manhole to manhole, cover may be reduced to an absolute minimum of 450mm or in accordance with manufacturers requirements where the manufacturer specifies a cover greater than 450mm based on the application and site conditions.

4.7.6 Road Crossings

Trenches through existing roads where required shall be backfilled using a 27:1 sand:cement mixture as per standard drawing *EN7901*. Road crossings shall be constructed perpendicular to the road centreline.

4.7.7 Sidelines

Sidelines shall not exceed 10m in length or provide more than two house connections. Where only one property is served, sidelines shall have a minimum grade of 1.67%.

Where the sideline is more than 2m deep, a manhole will be required at the junction with the sewer main.

Sidelines originating from dead-end mains shall not exceed 3m in length.

4.7.8 Junctions

A 150mm diameter sewer junction shall be provided within each allotment, at a depth sufficient to permit at least 90% of the allotment to drain via a pipe having minimum 600mm cover and laid at a minimum grade of 1.667%. The maximum desirable junction depth is 1.5m.

All junctions shall be constructed so that the riser cap is a minimum of 150mm above finished surface level using vertical shafts in accordance with standard drawing *EN7900*.

Junctions shall generally be located one metre from the property boundary, on the lowest side of the allotment.

Junctions shall be constructed at a 45-degree angle to the main using a 45-degree slab junction.

When a new junction is required to cut into an existing main, flexible joints on both sides of the junction shall be concrete encased in accordance with standard drawing *EN11576*.

4.8 MANHOLES

4.8.1 Location

Manholes shall be located along sewer mains at all changes in grade, level, and direction, and at intersections with other mains or dead ends exceeding 45 metres in length.

Manholes will not be accepted within the carriageway of public roads.

Manholes shall be located so that there is a minimum clear distance of 1m in all directions from the outside edge of the lid surround to any structure, that uninhibited access is always available and in a positioned that permits reasonable vehicular access.

The maximum permissible spacing between adjoining manholes is 90m.

Manholes shall be designed so that sewage is not forced to deflect by an angle of more than 90 degrees.

4.8.2 Materials

Manholes shall be constructed using a 25MPa concrete cast in-situ base in accordance with standard drawing *EN7898*. Either Type C or Type D cement shall be used in the concrete mix.

Sidewalls and covers shall be constructed from precast concrete components.

4.8.3 Construction

Manholes shall be constructed in accordance with standard drawing *EN7898*, including drop manholes. The minimum desirable fall through the manhole is defined in this drawing.

4.8.4 Drop Manholes

Drop manholes may only be used to avoid underground services, or at the intersection of shallow and deep mains where the difference in invert levels exceeds 450mm. The maximum difference in invert levels is 2m.

4.9 BUILDING OVER COUNCIL SEWER MAINS

Where any relevant Development Control Plan (DCP), Local Environment Plan (LEP) or Complying Development Certificate (CDC) conditions/standards do not allow structures to be built over sewer mains, no structures shall be built over Council's sewer reticulation system.

Where construction may be permitted by any relevant DCP/LEP/CDC conditions/standards, approval to build over the sewer reticulation system shall still be provided in writing by Council. No structures shall be built over Council's sewer reticulation system without the expressed written approval of Council.

Where permitted by relevant DCP/LEP/CDC and approved in writing, 150 and 225mm diameter gravity sewer reticulation mains may be built over, provided that the following conditions are met:

- The main shall be inspected using CCTV at the Developer's cost and digital footage presented to Council for inspection. The survey length is to extend 3m either side of the proposed development.
- If the sewer main is in an acceptable condition, Council may allow the main to remain in position. If the main is in an unacceptable condition, then Council will require that the main be replaced with a material of Council's nomination at full cost to the Developer.
- The sewer main shall be out of the zone of influence of any structural loads. This will require the use of piers or as detailed by a practicing structural engineer. Where loads upon the sewer main are unavoidable, Council may consider allowing the main to be concrete encased in accordance with standard drawing *EN7902*.
- Manholes, including a 1.5m radius around the manhole for access, are not built over.
- An indemnity is signed by the property owner, indemnifying Bathurst Regional Council from any liability due to repair of sewer infrastructure to private assets.

Gravity mains with a diameter greater than 225mm shall not be built over and structures shall not impart force via the zone of influence in any circumstance.

Sewer rising mains shall not be built over and structures shall not impact force via the zone of influence in any circumstance, regardless of diameter.

4.9.1 Exemption to Indemnity for Minor Lightweight Structures Adjacent to or over Sewer Mains

Council has determined that some common minor lightweight structures are considered unlikely to cause damage to Council's sewer infrastructure, and as such indemnities are unnecessary. Where a structure, as described in Table 9.5 below, is constructed, or proposed to be constructed, the landowner is not required to sign Council's standard indemnity.

Table 9.5 – Standard Indemnity Exceptions

	Development Type	Development Standard
1	Fences constructed of colorbond, timber paling or wire style	• The fence must not exceed more than 1.8m in height. • Footings and support posts must be 500mm clear of the sewer main.
2	Soft landscaping	• Shall not include hard standing/bound pavements such as concrete slabs or pavers greater than 100mm thick.
3	Garden sheds	• Shall not exceed 12m^2 in size. • Concrete slabs to support structure shall be no greater than 100mm thick and have no footings or piers.
4	Concrete sleeper & steel post retaining walls	• Height shall not exceed 1m. • No force shall be applied to the main via the zone of influence.

4.10 SEPTIC SYSTEMS

Septic systems are only allowable in locations as defined by the Bathurst Regional Council Local Environment Plan. Design and installation of such systems are subject to the normal Development Application Approval processes, via Bathurst Regional Council's Environmental, Planning & Building Services Department.

4.11 ZONE OF INFLUENCE DESIGN FOR SEWER MAINS AND SERVICES

All sewer mains (including rising mains) and services shall be designed with the zone of influence from any adjacent structures considered in accordance with *Section 1 – General, Clause 26*.

5. SEWER CONSTRUCTION GENERALLY

5.1 EARTHWORKS AND BACKFILLING

5.1.1 General

Generally, earthworks shall comply with *Section 5 – Earthworks.*

5.1.2 Sewerage Trench Excavation and Backfill

Sewerage trenches shall be excavated in accordance with standard drawing *EN7901*. The Developer shall further excavate, where necessary, to allow the pipes to be properly handled, jointed, packed and to permit the free use of caulking tools and to facilitate backfilling around the pipe. The bottom of the trench shall be neatly trimmed to give the pipes a uniform bearing for the whole of the length of each pipe and allow the placing and compaction of not less than 100mm of approved bedding material as per the standard drawing listed above.

Sewerage trenches shall be backfilled with materials as specified in the standard drawing *EN7901*, in layers not exceeding 200mm uncompacted thickness with a vibrating plate or other approved method. This includes backfilling with approved stabilised sand (sand:cement mixed at 27:1) batched and delivered by an approved concrete plant under all existing roadways.

5.1.3 Sewerage Manhole Excavation and Backfill

All sewerage manholes shall be excavated so that there is a minimum of 400mm between the outside of the manhole and the side of the trench. The Developer shall further excavate, where necessary, to allow the pit to be properly handled, jointed, packed and to permit the free use of caulking tools and to facilitate backfilling around the pit.

All sewerage manholes shall be backfilled with materials as specified in the standard drawing *EN7901*, in layers not exceeding 200mm uncompacted thickness with a vibrating plate or other approved method. This includes backfilling with approved stabilised sand (sand:cement mixed at 27:1) batched and delivered by an approved concrete plant under all existing roadways.

5.1.4 Unsuitable Bedding Subgrade Material

Where the subgrade excavation level consists of material which, when compacted at optimum moisture content, would be of insufficient bearing value, or for any other reason, as deemed by Council's Engineer which constitutes unsuitable subgrade material, the Developer shall excavate to such further depth as directed by Council's Engineer, backfill with an approved suitable material and provide a subgrade of acceptable bearing capacity.

Unsuitable material shall be replaced with granular or other approved fill material placed in layers not exceeding 200mm uncompacted thickness and compacted to 98% of the standard maximum dry density, when tested in accordance with *AS 1289*.

5.2 PIPES

5.2.1 Handling

The methods used for handling, laying and stacking pipes and manholes shall be such as to avoid damage to the pipes, pipe coating and lining, manholes, and shall comply with any recommendations made by the manufacturer. Cranes, skids or other approved devices shall be provided and used to ensure that pipes and pits are not dropped or bumped during loading, cartage, unloading or when being placed in the trench. Pipes shall not be lifted or suspended from hooks, lifting dogs, or other devices placed at their ends.

5.2.2 Bedding

Bedding material shall comply with *Clause 4.7.2.6* of this Section. The material shall be compacted to the bottom of the trench at the correct level for pipe laying.

"Bell-Holes" shall be excavated under each joint. Care shall be exercised that the pipes are evenly bedded and supported along the length of barrel of the pipe and that a 20mm clearance is maintained between the underside of the pipe collar and the bottom of the "Bell-Hole". Under no circumstances are pipes to be laid on their collars. After the pipe has been bedded to approval and the joint has been made, the recess under the bell shall be refilled with bedding material.

5.2.3 Laying

The methods used for pipe laying, jointing and installation of fittings shall conform to manufacturers specifications, particularly with respect to depth of entry of spigot ends. All cut ends of pipes shall be properly chamfered before joints are made.

The pipes shall be laid and jointed accurately to lines, gradients and levels shown in the approved drawings. All pipes shall be laid in such a manner that pipe barrels have solid bearing throughout their length.

Before pipes are laid, all dirt and foreign material that may have entered the pipe shall be removed and the outside of spigots and inside of sockets thoroughly cleaned of foreign matter.

Unless otherwise approved, laying shall commence at the low points of the pipelines and proceed uphill. All pipes shall be layed with collars in the upstream direction.

Short pipes shall be cast into manhole bases so that the first flexible joints in the pipeline outside the manholes are 150mm from the outside faces of manhole walls. Sockets of short pipes shall be supported in concrete extending from manhole bases. The first and last pipes in a line of sewer shall not be shorter than 300mm and no longer than 600mm. Special care shall be exercised when compacting the backfill around the first and last pipes to ensure that they are not displaced.

Where two or more lines of pipe are to be laid side by side, the space between the lines of pipe shall be of a width of 300mm, unless otherwise specified or shown on the approved drawings.

The open ends of dead-end sewers, junctions and manhole inlets for future connections shall be sealed off with capped pipes. The openings so sealed shall be subject to the same hydrostatic test as the sewer mains.

Junctions shall be constructed as shown on standard drawing *EN7900* and as detailed in *Clause 4.7.8* of this Section.

5.2.4 Jointing

5.2.4.1 Spigot and Socket Joints

All spigot and socket joints shall be slip-on type rubber gasket joints and shall be installed in accordance with the manufacturer's specifications, and the following additional requirements:

- Only lubricant recommended by the manufacturer shall be used. Oil and grease shall not be used as lubricant.
- The edges of cut pipes shall be rounded off or provided with a chamfer to avoid damage to the rubber gasket when making the joint.
- Each pipe shall be pushed into the socket to the correct depth, which is generally indicated by a painted stripe on the barrel at the spigot end. In the case of cut pipes or any other pipes which are not provided with painted stripes, a clearance of approximately 6mm shall be left between the spigot end of each such pipe and the bottom of the socket of the adjacent pipe or fitting. Cut pipes shall be marked prior to jointing to ensure that this clearance is achieved.

5.2.4.2 Flanged Joints

All flanged joints shall be installed in accordance with the manufacturer's specifications, and the following additional requirements:

- Flanged joints shall be carefully made with elastomeric gaskets provided by the manufacturer and the nuts shall be uniformly tightened.
- Gaskets, which cover only the flange face within the bolt holes, shall be fixed in position to one of the flanges with an approved adhesive. The Developer shall ensure that the bore of the flange is not obstructed by incorrect location of the elastomeric gasket.

5.2.4.3 Gibault Joints

Gibault joints are only to be installed when approved in writing by Council's Engineer. Generally, gibault joints will not be allowed for new works. Gibault joints shall be installed in accordance with the manufacturer's specifications and approximately 6mm clearance shall be left at the

centre of the sleeve between the ends of the pipes and/or fittings jointed.

5.2.5 Restraining/Anchoring

For rising mains, points in the pipeline where there are unbalanced forces shall be adequately restrained to withstand the forces resulting from the internal pressure when the pipeline is under test by embedding the pipe with concrete thrust blocks as approved by Council's Engineer provided that, notwithstanding any such approval, the Developer shall be responsible for any failure of the pipeline that may be due to inadequate restraint. The pressure used to calculate the required thrust block sizes shall be calculated based on the maximum working pressure in the line, including an allowance for water hammer and creep in accordance with *Clause 4.6* of this Section.

Steeply inclined pipelines with flexible joints shall be anchored by a combination of trench stops and concrete bulkheads. Unless otherwise specified or directed by Council's Engineer, where the pipe joints are not designed to withstand longitudinal forces, securing measures shall be in accordance with Table 9.6.

TABLE 9.6 – Sewer Pipe Anchoring Measures

Gradient	Anchoring Measures and Maximum Spacing (m)
Less than 6.5%	No anchoring required
6.5% to 10%	Trench stop (1) every third collar
10% to 15%	Concrete bulkheads (2) spaced no greater than 100 divided by the pipe gradient expressed as a %. Example for pipe on 12.5% grade: 100 ÷ 12.5% = 8m spacings
15% to 25%	Concrete bulkheads (2) spaced no greater than 100 divided by the pipe gradient expressed as a % multiplied by 2. Example for pipe on 20% grade: 100 ÷ (20%x2) = 2.5m spacings
Greater than 25%	Not permitted

(1) – trench stops shall be polyethylene bags with a minimum thickness of 0.25mm filled with clay or other approved material, sealed in an approved manner, placed under, around and to 300mm above the pipe at every third collar. Bags shall not be placed on sand bedding.
(2) – concrete bulkheads shall be constructed in accordance with standard drawing *EN7895*.

5.2.6 Polyethylene Sleeving

Wherever so specified, the Developer shall encase a pipeline, or part thereof, in polyethylene sleeving. Such sleeving shall be provided in addition to, but not as substitute for, any corrosion protection otherwise specified.

Application of the polyethylene sleeving and adhesive tape shall be in accordance with the manufacturer's instructions, and the Developer shall take due care not to damage the sleeving during its application or during the backfilling of the trench. Each pipe shall be encased in a length of sleeving, overlapped for a minimum of 250mm at each field position with at least 3 circumstantial turns of adhesive tape. As the polyethylene sleeve material covering the pipe will be loose, excess material shall be neatly drawn up around the pipe barrel, folded into an overlap on top of the pipe and held in place by means of strips of plastic tape at approximately one metre intervals. Bends, tapers and similar fittings shall be covered by polyethylene sleeving as specified for the pipes. Valves, hydrants and irregular shaped fittings shall be hand wrapped using flat polyethylene sheets and securing these with plastic adhesive tape to provide an adequate seal. The flat polyethylene sheets may be obtained by splitting suitable lengths of tubing.

Any damage made to the polyethylene sleeving before or after backfilling of the trench shall be made good by the Developer to the satisfaction of Council's Engineer.

5.3 MANHOLES

Sewer manholes shall be constructed in accordance with standard drawing *EN7898*. Hobs shall be neatly trowelled, or float finished.

Manhole covers shall be finished flush with paved surfaces, 25mm above grassed surfaces and 75mm above ground in open or unfinished areas. Covers and lids shall comply with the required load class and shall sit firmly and evenly without rocking and aim to provide a waterproof seal.

5.4 CORROSION PROTECTION OF STEEL BOLTS AND NUTS

All steel bolts and nuts used for installation below ground shall be thoroughly coated, after the nuts have been tightened, with an approved corrosion protecting material, which is acceptable to Council's Engineer. Bolts and nuts shall be dry, clean and free from rust immediately before application of the coating. Stainless steel bolts and nuts need not be coated.

5.5 CONNECTIONS

Where the Contract requires a connection or an alteration to be made to an existing manhole through which sewerage is flowing, the connection shall not be made until Council's Engineer gives permission and states the method by which the connection shall be made. Care shall be taken that no construction or other extraneous materials be permitted to enter the "live" sewer. The flow from existing inlet pipes (if any) to the existing manhole shall be maintained through the manhole during the Developers operations.

5.6 SEALED MANHOLES

Where sealed manholes are specified, they shall be constructed as per standard manholes, but with sealed lids to prevent the ingress of water.

6. TESTING & SURVEY REQUIREMENTS

Where testing and survey items are specified by Consent Conditions or Council's engineer, the Developer shall arrange for the testing to be undertaken. Testing shall be treated as a hold point in the development and subsequent works shall not proceed until approval has been given.

Where specified, tests shall be undertaken in accordance with Australian Standards by a NATA approved testing laboratory. All test results from the NATA approved testing laboratory shall be filed and provided to Council, regardless of the results of the testing.

6.1 MATERIALS

All materials shall be proven to be compliant with the requirements of this Section by provision of material specifications and/or NATA laboratory testing.

6.2 TESTS & SURVEY

- Sewerage pipe bedding/backfill material testing to confirm compliance with *Clause 4.7.2.6* of this Section by NATA laboratory.
- Trench backfill supervision by Level 1 GITA or SMDD testing by Level 2 GTA or NATA laboratory.
- Air pressure testing of pipes in accordance with *Clauses 6.2.2.1 and 6.2.2.2* of this Section by NATA laboratory.
- Water testing of manholes in accordance with *Clause 6.2.3* of this Section by NATA laboratory.

- Survey during construction works.
- Works as executed survey by registered surveyor.

6.2.1 Closed Circuit Television (CCTV) Inspections

Where sewer main has been constructed in the development, the Developer will be required to carry out a colour CCTV inspection as detailed in this Clause.

The colour CCTV inspection shall include cleaning of the sewer network. The cleaning equipment used shall be capable of removing dirt, grease (fat), rocks, sand, surface encrustations and other material and any obstructions from the sewer lines and manholes. Passing material from manhole section to manhole section shall not be permitted. The Developer shall be responsible for the proper disposal of the waste material.

The initial cleaning pass pressure shall not be greater than 800psi. Subsequent passing may be carried out at a higher pressure, but the Developer shall be responsible for rectifying any damage.

Distance measurement, in all instances, shall commence from the manhole/pipe entry to the end of the pipe section being surveyed. The camera and illumination system shall be capable of providing a clear, accurate and in-focus record of the pipe's internal condition.

At the start of each manhole length, the following additional information shall be electronically generated and displayed:

- Street Name
- Start & Finish Manhole/Node Numbers
- Direction of survey from Manhole to Manhole
- Diameter of pipe and material type
- Date of Survey

A copy of the videotape in .avi or .mp4 format along with an inspection report in PDF format will be required to be provided to the Principal in a portable USB flash drive or DVD.

All defects identified in the CCTV footage shall be repaired at full cost to the Developer to the satisfaction of Council's Engineer.

6.2.2 Air Pressure Testing of Pipes

6.2.2.1 Gravity Pipes

Before testing sewer mains, all pipe on the section to be tested shall be completed and backfill shall be compacted to the level of the centre of the pipe barrel.

The procedure for air testing of sewer mains is:

1. Plugs to be securely fitted to each end of the line.
2. The line is slowly pumped up to 28 kPa (if the line cannot be pumped up, or will not hold, then there is a leak that requires repair).
3. If necessary, hold the pressure at 28 kPa to allow the air temperature to stabilise for 2 minutes.
4. The line is closed off and fittings are disconnected.
5. The pressure is then monitored for 2 minutes for 150mm pipe (4 minutes for 225mm and above).

6. If the pressure is above 18 kPa, the line is deemed to have passed the test.

Any failures shall be rectified by the Developer at their own expense, and a satisfactory test obtained prior to the remaining backfill being placed.

6.2.2.2 Air Pressure Testing of Rising Main Pipes

At Consent stage, the Developer shall submit proposed testing methodology details for all rising main lines by a NATA laboratory. The pressure at which the mains are tested shall be in accordance with the requirements of *Clauses 4.6 and 5.2.5* of this Section.

6.2.3 Water Testing of Manholes

Each completed manhole shall be tested for leakage. The test shall be carried out with the manhole cover surround fitted and rendering of the channels and benches completed.

The procedure for the water testing of manholes shall be as follows:

1. Plugs shall be securely fitted to the end of each pipe.
2. The manhole filled to the top with water.
3. After 10 minutes of absorption, the manhole shall be refilled to the lip of the surround.
4. The drop in water level over 10 minutes is measured.
5. If the level drops less than 5mm per metre depth, the manhole has passed the test.

Any failures shall be rectified by the Developer at their own expense, and a satisfactory test obtained prior to the remaining backfill being placed.

6.3 TESTING & SURVEY SPECIFICATION

All items listed in *Clause 6.2* of this Section shall comply with the requirements of this Clause. Tables 9.7 to 9.10 detail the required test types, results, tolerances and frequencies of testing.

TABLE 9.7 – Required Tests and Survey Description

Item	Required Tests and Survey Description
Sewerage pipe bedding/backfill material	• Particle size distribution test in accordance with *AS 1289*.
Trench backfill	• SMDD compaction test to *AS 1289*.
Air pressure testing of pipes	• Air pressure test in accordance with *Clause 6.2.2* of this Section.
Water testing of manholes	• Water test in accordance with *Clause 6.2.3* of this Section.
Survey during works	• All installed sewerage junctions including risers, joins and bends shall be surveyed prior to backfill.
Works as executed survey	• All installed sewerage manholes/structures shall be surveyed to show centre and full extent of structure. • All installed sewerage manholes/structures shall be surveyed to show top, hob and invert level. • All installed sewerage pipes shall be surveyed to show invert level at pits/outlet structures.

TABLE 9.8 – Required Results

Item	Required Results
Sewerage pipe bedding/backfill material (1)	• Particle size distribution to comply with *Clause 4.7.2.6* of this Section.
Trench backfill (2)	• SMDD shall be 98% at ± 2% optimum moisture content.
Air pressure testing of pipes (3)	• All parameters detailed in *Clause 6.2.2* of this Section shall be met.
Water testing of manholes (3)	• All parameters detailed in *Clause 6.2.3* of this Section shall be met.
Survey during works (4)	• Junction locations shall target design
Works as executed survey (4)	• Top and invert level of manholes/structures shall target design. • Centre location of manholes/structures shall target design. • Invert levels of sewerage pipes at manholes/structures shall target design.

(1) – if material does not meet the requirements, an alternate material shall be sourced.

(2) – failure to achieve any of the required results means non-compliance for the trench, 50m in each direction of the failed test or between the two service pits.

(3) – failure to achieve any of the required results will result in non-compliance.

(4) – see Table 9.9 for tolerances.

TABLE 9.9 – Sewerage Level and Alignment Tolerances

Item	Tolerance
Top and invert level of manholes/ structures	No more than 20% of survey points to be outside of ± 40mm of design
Centre location of manholes/ structures	No more than 20% of all survey points to be outside of ± 50mm of design
Pipe invert levels at manholes/structures	No more than 20% of survey points to be outside of ± 40mm of design

TABLE 9.10 – Required Test Frequencies for NATA Laboratory Works

Item	Required Frequency
Sewerage pipe bedding/backfill material	• One test and inspection every 250m^3.
Trench backfill	• SMDD tests shall be undertaken for every second layer with the following requirements: o One test every 40m of trenching, including at least one test between all service pits/changes in direction. o For each played layer, the testing location will be randomly changed from the location of the test on the previous layer.

SECTION 10 – CONCRETE STRUCTURES

1. INTRODUCTION

This Section of the Engineering Guidelines outlines Council's requirements for the design and construction of concrete kerbs, drains, median islands, footpaths, cycleways, shared paths, driveways/accesses, laybacks and perambulator crossings.

2. STANDARDS

Unless otherwise specified or approved, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standards listed in this Section.

Standards relevant to this Section include, but are not limited to:

- *AS 1012 – Methods of testing concrete*
- *AS 1141 – Methods for sampling and testing aggregates*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 1379 – Specification and supply of concrete*
- *AS 1478.1 – Chemical admixtures for concrete, mortar and grout – Admixtures for concrete*
- *AS 1554.3 – Structural steel welding – Part 3: Welding of reinforcing steel*
- *AS 2425 – Bar chairs in reinforced concrete – Product requirement and test methods*
- *AS 2758.1 – Aggregates and rock for engineering purposes – Concrete aggregates*
- *AS 2876 – Concrete kerbs and channels (gutters) – Manually or machine placed*
- *AS 3582 – Supplementary cementitious materials*
- *AS 3600 – Concrete structures*
- *AS 3610 – Formwork for concrete*
- *AS 3799 – Liquid membrane-forming curing compounds for concrete*
- *AS 3972 – General purpose and blended cements*
- *AS 3996 – Access covers and grates*
- *AS 4671 – Steel reinforcing materials*
- *Standards Australia Handbook 84 – Guide to concrete repair and protection*

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN7876 – Kerb and Gutter and Layback Details*
- *EN7877 – Perambulator Crossing Details*
- *EN7878 – Street Intersection Median Island*
- *EN7879 – Concrete Footpath, Cycleway & Shared Path Details*
- *EN7881 – Rural Access and Standard Concrete Drain Details*
- *EN7882 – Urban Access Details*
- *EN9161 – Floodway within Footpath Details*
- *EN12046 – Urban Road Typical Layout & Verge Details in Greenfield Sites from 21 September 2023*

3. CONCRETE

3.1 GENERAL

The Developer shall always use ready-mixed concrete for the works.

All ready-mixed concrete shall comply with *AS 1379* and all other relevant Australian Standards and be supplied from an approved supplier. Unless otherwise specified, concrete shall have an absolute minimum strength of 25MPa (or as specified) and have a maximum aggregate size of 20mm.

Council's Engineer may require that the Developer undertake tests on the materials and concrete in conformity with the relevant Australian Standard.

Any material which fails to comply with the requirements of Australian Standards, or which does not conform to the approved nominated mix, shall be removed from the site within twenty-four hours.

4. TESTING & SURVEY REQUIREMENTS

Where testing and survey items are specified by Consent Conditions or Council's engineer, the Developer shall arrange for the testing to be undertaken.

Where specified, tests shall be undertaken in accordance with Australian Standards by a NATA approved testing laboratory. All test results from the NATA approved testing laboratory shall be filed and provided to Council, regardless of the results of the testing.

Where a development requires multiple concrete types (kerbs, drains, median islands, concrete paths, driveways/accesses, laybacks and perambulator crossings) which require different mix designs and placement methodologies, the Developer will be required to obtain all required approval certificates for each individual concrete/mix type.

4.1 MATERIALS

All materials shall be proven to be compliant with the requirements of this Section by provision of material specifications and/or NATA laboratory testing.

4.2 TESTS & SURVEY

- Nominated mix compressive strength (F28) at 28 days by NATA laboratory – required for kerbs, drains, median islands, footpaths, cycleways, driveways/accesses, laybacks and perambulator crossings.
- Production mix compressive strength (F28) at 28 days taken onsite during delivery by NATA laboratory – required for kerbs, drains, median islands, footpaths, cycleways, driveways/accesses, laybacks and perambulator crossings.
- Level survey by registered surveyor and straightness and finished properties inspection with Councils engineer – required for kerbs, drains, median islands, footpaths, cycleways, driveways/accesses, laybacks and perambulator crossings.

4.3 TESTING SPECIFICATIONS

Where test or survey items listed in *Clause 4.2* of this Section are specified as a Development requirement, testing procedures shall comply with the requirements of this Clause. Tables 10.1 to 10.5 describe the required test types, results, tolerances and frequencies of testing.

TABLE 10.1 – Required Tests and Survey Description

Item	Required Tests and Survey Description
Nominated mix 28-day compressive strength	• Concrete compressive strength test to *AS 1012*.
Production mix 28-day compressive strength	• Concrete compressive strength test to *AS 1012*.
Level and straightness and finished properties compliance	• Survey undertaken by registered surveyor on all finished concrete (works as executed survey will be acceptable). • Inspection of straightness. • Inspection of finish homogeneity.

TABLE 10.2 – Required Results

Item	Required Results
Nominated mix 28-day compressive strength (1)	• No samples can be less than the specified strength.
Production mix 28-day compressive strength (2)	• Shall be specified strength.
Level and straightness and finished properties compliance (3)	• Levels shall target design. • Straightness shall be uniform. • Finish properties shall be homogenous.

(1) – failure to achieve the required results means that the nominated mix is non-compliant, and modifications need to be made to the nominated mix before approval is given for the mix to become the production mix.

(2) – see Table 10.3 for tolerances.

(3) – see Table 10.4 for tolerances.

TABLE 10.3 – Concrete Production Mix Tolerances

28-day compressive strength	Tolerance - % by which test strength may be less than specified strength
Average of all samples	Maximum of 5%
Any one sample	Maximum of 10%

TABLE 10.4 – Concrete Level, Straightness and Finished Properties Tolerances

	Item	Tolerance
Concrete	Level	No more than 50% of all survey points to be outside of ± 20mm of design
		No more than 10% of survey points to be outside of ± 50mm of design
	Straightness	Surface levels - 5mm maximum departure from a 3m straight edge in any direction
		Alignment – shall not deviate more than 10mm along entire length of edge
	Finished properties	Must be homogenous in appearance, no cracking

TABLE 10.5 – Required Test Frequencies for NATA Laboratory Works

Item	Required Frequency
Nominated mix 28-day compressive strength	• Minimum of two test samples.
Production mix 28-day compressive strength	• For concrete paths, median islands, driveways, laybacks and perambulator crossing - whichever is greatest of a minimum of three samples or one sample every 50m^3 to be taken randomly from concrete being placed. • For kerbs and drains - whichever is greatest of a minimum of three samples or one sample every 25m^3 to be taken randomly from concrete being placed.

SECTION 11 – OPEN SPACE AREAS

1. SCOPE

This Section of the Guidelines for Engineering Works outlines Council's requirements for the development of open space areas.

2. STANDARDS

Unless otherwise specified, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standard listed in this Section.

Standards relevant to this Section include, but are not limited to:

- *AS 1428 – Design for access and mobility*
- *AS 2303 – Tree stock for landscape use*
- *AS 3700 – Masonry structures*
- *AS 4685 – Playground equipment and surfacing*
- *AS 16630 – Permanently installed outdoor fitness equipment*
- *All development consent conditions*

2.1 BATHURST REGIONAL COUNCIL STANDARD DRAWINGS

- *EN12014 – Regular Tree Planting Details*
- *EN12047 – Earthworks Details at Subdivision and Dwelling Stages*
- *EN12050 – Open Space Vehicle Barrier and Access Details*

3. DEFINITIONS

- **Drainage Reserve –** any area which contains minor or major system drainage elements in addition to draining the reserve itself. Drainage reserves may form part of open space areas or be dedicated for drainage purposes only.
- **Open Space –** all areas defined as open space or park in the applicable Development Control Plan (DCP) or development consent conditions. Includes, but is not limited to, "Open Space", "Passive Open Space", "Land Use Buffer", "Major Road Buffer", "Environmental Protection Areas", "Vegetation Screens", "District Sports Park", "District Community Park", "Local Community Park" and "Passive Open Space" areas defined by any applicable DCP or consent condition. Open space areas may include, and have specific requirements for, drainage reserves and recreation areas.
- **Recreation Area –** any area within an open space area required to be suitable for recreational purposes by the public. Shall have a maximum slope of 6%.
- **Sloped Area -** any area within an open space area that has a slope exceeding 6% including batters. All sloped areas must be approved at application stage. Shall have a maximum slope of 1:6.
- **Maintenance Channel –** any channel which has been classified as requiring maintenance. Generally, the primary function of these channels is to perform engineering functions rather than environmental functions. Low flow drainage is required to these channels to ensure that the channel can be mowed/maintained.
- **No Maintenance Channel –** any channel which has been classified as not requiring maintenance. Generally, the primary function of these channels is to perform environmental functions rather than engineering functions. Low flow drainage in these channels is not permitted under any circumstances.

4. LANDSCAPING OF OPEN SPACE AREAS

4.1 GENERAL

Landscaping and furnishing plans for open space areas in the development shall be submitted at Development Application and Construction Certificate stages.

The classification of specific open space areas shall be as defined in the DCP.

Open spaces shall always be designed with the intention of maximising recreation areas and minimising sloped areas whilst meeting drainage and vegetation requirements.

All open space areas shall be suitable for ride-on mower maintenance with the following requirements:

- Finished surface shall be of uniform level and grade free from undulations, hollows, sudden level changes and free from rock and debris.
- A minimum of 2.4m clearance between any two structures that prevent a clear travel path for safe mowing including, but not limited to, retaining walls, fences, vegetation, seating, play equipment and signage. Where a 2.4m clearance between structures cannot be provided, the area between the two structures shall be infilled with concrete 125mm thick in a colour specified by Council.
- The 2.4m clearance area shall be of uniform slope not exceeding 6% in recreational areas and not exceeding 1:6 in approved sloped areas. Where a slope steeper than 1:6 is approved, the slope shall be provided with a maintenance free finish approved by Council.
- A minimum 500mm wide concrete edge strip or 1m wide concrete drain (where required for site conditions) to the rear of any retaining structure to prevent the need for mowing adjacent to the drop.
- A minimum 300mm wide concrete edge strip to the front of any retaining structure to allow for mower only maintenance.

Where vegetation establishment forms part of landscaping works, see *Section 4 – Site Restoration & Landscaping* for requirements.

4.2 OPEN SPACE AREAS WITHOUT DRAINAGE REQUIREMENTS

The following general requirements shall be used for landscaping and furnishing open space areas that do not incorporate drainage reserve features:

- Shall be grassed in accordance with *Section 4 – Site Restoration & Landscaping*. 150mm minimum of topsoil to be provided to full extent of the reserve. Reserve to have full grass cover and establishment prior to completion of subdivision.
- Shall have tree, shrub and grass plantings as required to meet development consent conditions.
- Where practicable, shall be surrounded by road reserves on all sides. Locating open space areas adjacent to residential allotment boundaries shall be minimised.
- Footpath, cycleway or shared footpath (whichever applies) access shall be provided to at least two sides of the reserve. Where the open space area is terraced with retaining walls or slopes between recreational areas, at least one access shall be provided to each terrace/tier/level.
- The minimum slope in recreational areas shall be 1% to a legal point of stormwater discharge.

- The maximum slope for recreation areas shall be 6%. Retaining walls may be provided to achieve the maximum slope. Retaining walls shall not have an effective fall height exceeding 900mm and shall be constructed from masonry blocks in an approved colour.
- Sloped areas between recreation areas or to the perimeter of recreational areas must be approved at application stage, otherwise the maximum recreational area slope of 6% shall be enforced.
- Timber bollards to be placed to full perimeter of open spaces areas in accordance with standard drawing *EN12050* to prevent vehicle access.
- Padlock lockable gate in accordance with standard drawing *EN12050* to be provided at two locations to allow service vehicle access. Where the open space area is terraced with retaining walls or slopes between recreational areas, at least one service vehicle access shall be provided to each level. All gates/terrace level accesses shall be a minimum width of 4m side to allow service vehicle access.
- A 32mm water service and meter shall be provided.
- A sewer connection shall be provided to the lowest point.

4.3 OPEN SPACE AREAS WITH DRAINAGE REQUIREMENTS

The following general requirements shall be used for landscaping and furnishing open space areas that which also incorporate drainage reserve features:

- Shall be grassed in accordance with *Section 4 – Site Restoration & Landscaping*. 150mm minimum of topsoil to be provided to full extent of the reserve. Reserve to have full grass cover and establishment prior to completion of subdivision.
- Tree, shrub and grass plantings as required to meet development consent conditions. Vegetation shall be appropriate for classification of channel (“Maintenance” or “No Maintenance”).
- Footpath, cycleway or shared footpath (whichever applies) access shall be provided to at least two sides of the reserve. Where the open space area is terraced with retaining walls or slopes between recreational areas, at least one access shall be provided to each terrace/tier/level.
- The minimum slope in recreational areas shall be 1% to a legal point of stormwater discharge.
- The maximum slope for recreation areas shall be 6%. Retaining walls may be provided to achieve the maximum slope. Retaining walls shall not have an effective fall height exceeding 900mm and shall be constructed from masonry blocks in an approved colour.
- Sloped areas between recreation areas or to the perimeter of recreational areas must be approved at application stage, otherwise the maximum recreational area slope of 6% shall be enforced.
- Timber bollards to be placed to full perimeter of open spaces areas in accordance with standard drawing *EN12050* to prevent vehicle access.
- Padlock lockable gate in accordance with standard drawing *EN12050* to be provided at two locations to allow service vehicle access. Where the open space area is terraced with retaining walls or slopes between recreational areas, at least one service vehicle access shall be provided to each level. All gates/terrace level accesses shall be a minimum width of 4m side to allow service vehicle access.
- A 32mm water service and meter shall be provided.
- A sewer connection shall be provided to a location approved by Councils engineer.
- Grassed swales shall have a minimum base width of 2.5m.

- Shall comply with the requirements of *Section 7 – Stormwater & Subsoil Drainage, Clauses 5,6 and 7*.

4.4 DEDICATED DRAINAGE RESERVES

The following general requirements shall be used for areas dedicated to being a drainage reserve only:

- Shall be grassed in accordance with *Section 4 – Site Restoration & Landscaping*. 100mm minimum of topsoil to be provided to full extent of the reserve. Reserve to have full grass cover and establishment prior to completion of subdivision.
- Tree, shrub and grass plantings as required to meet development consent conditions. Vegetation shall be appropriate for classification of channel ("Maintenance" or "No Maintenance").
- The maximum slope shall be 1:6.
- Timber bollards to be placed to full perimeter of open spaces areas in accordance with standard drawing *EN12050* to prevent vehicle access.
- Padlock lockable gate in accordance with standard drawing *EN12050* to be provided at two locations to allow service vehicle access. All gates/accesses shall be a minimum width of 4m side to allow service vehicle access.
- Grassed swales shall have a minimum base width of 2.5m.
- Shall comply with the requirements of *Section 7 Stormwater & Subsoil Drainage, Clauses 5, 6 and 7*.
- May be located adjacent to residential allotment boundaries provided that a suitable buffer is provided.

5. OPEN SPACE AREAS FURNISHINGS & EQUIPMENT

The Developers requirements regarding provision of furnishings and equipment to open space areas in addition to landscaping will be detailed at application stage. This may include a combination of the below items:

- Furnish open space areas at development stage in accordance with specifications provided at application stage.
- Provide developer contributors for Council to purchase and install furnishings and equipment after completion of the development.

SECTION 12 – WATER SENSITIVE URBAN DESIGN

1. INTRODUCTION

This Section of the Guidelines for Engineering Works outline Council's requirements for design and construction of Water Sensitive Urban Design (WSUD) infrastructure.

2. STANDARDS & REFERENCES

Unless otherwise specified or approved, materials and workmanship shall be in accordance with the latest relevant Australian Standard or standards listed in this Section.

Standards include, but are not limited to:

- *AS 1141 – Methods for sampling and testing aggregates*
- *AS 1289 – Methods of testing soils for engineering purposes*
- *AS 2758 – Aggregates and rock for engineering purposes*
- *AS 3706 – Geotextiles – methods of test*
- *AS 4133 – Methods of testing rocks for engineering purposes*
- *AS 4419 – Soils for landscaping and garden use*
- *AS 5667 – Water quality – sampling guidance*

3. WATER QUALITY DESIGN CRITERIA & TARGETS

3.1 POLLUTION REDUCTION TARGETS

The water quality targets shown in Table 12.1 below shall apply to all urban development. The targets are total values to be achieved from a development/redevelopment site. Targets may be achieved by a single treatment or by several measures in a treatment train.

TABLE 12.1 – WSUD Pollution Reduction targets

Pollutant	Development/ Redevelopment Sites
Gross pollutant export load	90%
Average annual suspended solids (SS)	60%
Average annual total phosphorus (TP)	45%
Average annual total nitrogen (TN)	40%

3.2 DESIGN & MODELLING

Full details of the water quality modelling methodology undertaken shall be provided including all assumptions, recommended parameter values, tabulated flow comparisons for major and minor systems and percentage reduction in annual pollutant loadings.

It shall be proven that all water quality improvement methods are appropriate for Bathurst conditions and a lifecycle cost assessment shall be provided for all infrastructure. Required maintenance on proposed infrastructure shall be minimised.

3.2.1 MUSIC Modelling

Music modelling shall be undertaken to simulate rainfall and pollution generation to determine compliance with the pollution reduction targets specified in *Clause 3.1* of this Section.

3.2.1.1 Hydrology

Design rainfall intensities for the Bathurst Regional Council Local Government Area shall be obtained from the online ARR Data Hub based on the design storm duration and annual exceedance probability. The data used shall be the most recently published.

3.2.1.2 WSUD Treatment Devices

Detailed information shall be provided on how all treatment devices have been modelled as part of the MUSIC modelling.

3.2.1.3 Parameters

The standard parameters that shall be used for modelling hydrology in MUSIC are detailed below in Table 12.2.

TABLE 12.2 – MUSIC Hydrology Parameters

Parameter	Urban & Rural Value
Impervious Area Properties	
Fraction Impervious	To be calculated
Rainfall Threshold (mm/day)	0
Pervious Area Properties	
Soil Storage Capacity (mm)	40
Initial Storage (% of capacity)	20
Field Capacity (mm)	25
Infiltration capacity coefficient - a	200
Infiltration capacity coefficient - b	1
Groundwater Properties	
Initial Depth (mm)	1
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	1
Daily Deep Seepage Rate (%)	15

The standard parameters that shall be used for modelling water quality parameters in MUSIC are detailed below in Table 12.3.

TABLE 12.3 – MUSIC Water Quality Parameters

Parameter	Rural	Urban
General		
Estimation Method	Mean	Mean
Standard Deviations – std dev (log mg/L)	0	0
Serial Correlation (R squared)	0	0
Total Suspended Solids		
Base Flow Concentration – mean (log mg/L)	1.40	1.10
Storm Flow Concentration – mean (log mg/L)	2.041	2.19
Total Phosphorus		
Base Flow Concentration – mean (log mg/L)	-0.88	-0.82
Storm Flow Concentration – mean (log mg/L)	-0.662	-0.65
Total Nitrogen		
Base Flow Concentration – mean (log mg/L)	0.074	0.32
Storm Flow Concentration – mean (log mg/L)	0.314	0.427

4. GROSS POLLUTANT TRAPS

4.1 LOCATION

Gross Pollutant Traps (GPT's) shall be located either:

- Within the pipe system with the structure below finished surface level.
- Within an engineered waterway with the structure at or below finished surface level.

GPT's may be used whenever desired as part of a treatment train to achieve pollution reduction targets but shall always be used in the following circumstances:

- Prior to the inlet of any water retaining asset with permanent storage.
- Prior to a receiving natural waterway or engineered major system drainage structure whenever the catchment area exceeds 5 hectares.

4.2 ACCESS

GPT's shall be accessible by a 12m single unit truck. The access to the GPT shall be directly off a Local Access, Collector or Distributor Road. Surfacing of the access to the GPT shall be concrete or asphalt.

4.3 DESIGN, PERFORMANCE & CLASSIFICATION

The following factors shall be considered when selecting and designing GPT's:

- Treatment objectives – define the treatment objectives for the project and each individual GPT. Classify GPT treatment objectives in accordance with Table 12.4 below.
- Hydraulics – analyse the hydraulics of the drainage system including the head loss of all GPT's and diversion weir under flood conditions. Ensure that the bypass system coordinates with the minor and major systems and check for any flooding consequences.
- Pollutant removal – assess the pollutants likely to be collected and determine the required holding capacity with respect to frequency of maintenance. Other factors that shall also be considered include:
  - Catchment size.

- Pollutant load and treatment targets.
- Inlet and outlet conditions.
- Footprint and depth of the unit.

- Maintenance requirements – design with the following considerations:
  - Ease of access and maintenance.
  - Special equipment requirements.
  - Frequency of maintenance.
  - Life cycle costing.
  - Work health and safety.

Design documentation shall be provided detailing how the above factors have been suitably considered and that all GPT's will function as intended.

TABLE 12.4 – GPT Classification

Classification	Description & Function
Floating Debris Traps	Litter capture on permanent water bodies
Trask Racks & Litter Control Devices	Hard or soft litter capture devices for pipelines and engineered waterways
Sediment Traps	Sediment removal only on pipelines
DUS GPT's	Sediment and litter capture for pipelines or engineered waterways
Proprietary Devices	Range of custom devices, mainly used for pipelines

APPENDICES

A. Engineering Design Certification

B. B.R.C. Engineering Design Checklist

C. B.R.C. Engineering Drafting Checklist

APPENDIX A – ENGINEERING DESIGN CERTIFICATION

Project / Development: .....
Development Application Number: .....
Consultant's Plan Number(s): .....
Name of Consultant: .....
Name and Address of Developer: .....
.....
.....

I certify that the attached engineering checklists provide a valid record of the subject development.

I certify that this development complies with good industry practice, Bathurst Regional Council's Guidelines for Engineering Works, and specific instructions from the Director of Engineering Services, with the exception of any departures cited in the attached check lists.

I certify that this development will have no significant environmental impact as interpreted under Part V of the Environmental Planning and Assessment Act, 1979, as amended.

I certify that this development is in strict compliance with all conditions of development consent, unless written confirmation from Council has been received approving of any variance prior to the submission of design plans (including designs for staged construction).

I certify that all structural elements of the work have been constructed by a competent Contractor to the approved design.

I certify that all pavements comply with the design, using materials complying with Council standards.

Design Engineer / Surveyor:

NAME .....

SIGNATURE .....

DATE .....

QUALIFICATIONS .....

NPER-3 REGISTRATION NUMBER (if applicable).....

Contact Details:

PHONE .....

COMPANY .....

POSTAL ADDRESS .....
.....

APPENDIX B - B.R.C. ENGINEERING DESIGN CHECKLIST

To be completed by relevant Design Engineer/s and Surveyor/s (word version can be supplied on request)

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
GENERAL				
Site Investigation/Pre-Design/Planning				
On-site walkthrough to obtain better understanding of features, terrain etc				
Previous land uses reviewed, and potential issues identified (contamination report review)				
Environmental design requirements identified (flora & fauna impact assessment/review of environmental factors/environmental impact assessment/statement of environmental effects reports review)				
Heritage design requirements identified (Aboriginal cultural heritage assessment/European heritage impact assessment reports review)				
Traffic control constraints and requirements identified (closures, diversions, impact on public, temporary road required etc.)				
Acoustic design requirements identified (acoustic assessment report)				
Crime risk design requirements identified (crime risk report)				
Development consent design requirements identified				
Construction constraints identified (access, space, setup, benching etc considered)				
Cadastral and topographic surveys undertaken by suitably qualified persons				
Flood impact assessment required				
Acoustic assessment required				
Fisheries permit required				
General (Consent Conditions and BRC Guidelines for Engineering Works)				
Design complies with all relevant Australian Standards				
TfNSW approval obtained for works on classified roads				
Bulk earthworks cut/fill details provided				
Slope management plan provided				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Site survey detailing existing site features as required for accurate design undertaken by suitably qualified surveyor				
Location of state survey marks to be installed shown and approved by suitably qualified surveyor				
Existing public and private property to be impacted by Development/design clearly identified. Written approval from the owner of affected properties to accompany design plans				
Existing services located, classified and drafted in accordance with AS5488				
Design checked for clashes with existing services/infrastructure				
NSW Streets Opening Coordination Council design guide followed				
Horizontal and vertical clearances (considering conduit outer diameters) between services achieved in accordance with BRC Guidelines				
Service mains underground warning tape clearly detailed				
Engineering plans and details for all non-standard drainage/water/sewer/general infrastructure provided				
Engineering plans for all retaining walls provided				
Electricity (including lighting), telecommunications and gas services design by suitably qualified persons and approved by relevant Supply Authority and incorporated into overall design & plans				
Future infrastructure/expansions/requirements considered in design				
Vegetation preserved where practical				
Vegetation species selected to handle periodic drought/waterlogging				
Landscaping assessed to ensure safety will not be lowered with mature or seasonal growth (e.g. sight distance, obscuring signs, shading, slippery carriageway) or by water ponding on roadway				
Traffic management and traffic guidance schemes developed				
Handrail and balustrade detailed to all drop offs in accordance with BRC Guidelines Section 1				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Zone of influence assessment for Council Services in accordance with EN7902 and BRC Guidelines Section 1				
Site restoration plan detailing remediation measures for all disturbed areas and surface finishes for all areas detailed in accordance BRC Guidelines Section 4				
Landscaping plan providing in accordance with consent conditions and BRC Guidelines Sections 4 and 11				
Grass cover species clearly identified				
Earthworks slopes suitable for maintenance & purpose				
Detailed earthworks cut/fill volumes calculated				
Minimum slope of 1% and maximum slope of 20% achieved on all allotments				
Structural design undertaken by suitably qualified persons				
Existing easements shown along with proposed easements				
Boundaries/allotment base drawn by registered surveyor & linked to observed survey marks				
Boundaries close to appropriate level of accuracy				
Existing telecommunications infrastructure within design area shown on drawing (provide description in comments column)				
Existing power infrastructure within design area shown on drawing (provide description in comments column)				
Existing gas infrastructure within design area shown on drawing (provide description in comments column)				
Existing water infrastructure within design area shown on drawing (provide description in comments column)				
Existing sewer infrastructure within design area shown on drawing (provide description in comments column)				
Existing drainage infrastructure within design area shown on drawing (provide description in comments column)				
Other existing service infrastructure within design area shown on drawing (provide description in comments column)				
Existing Council owned vegetation within design area shown on drawing (provide description in comments column)				
ROAD DESIGN				
General (Austroads Guide to Road Design Part 3: Geometric Design & BRC Engineering Guidelines)				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Class of road determined in accordance with BRC Guidelines Section 6				
Road and lane widths in accordance with BRC Guidelines Section 6 & Austroads Road Part 3 Section 4				
Road edge treatment determined in accordance with BRC Guidelines Section 6				
Design vehicles identified including buses, garbage trucks and emergency vehicles				
Pedestrian, pram, cyclist & motorcyclist requirements considered				
Alignments/construction footprint avoids major constraints/controls				
Operating design speeds determined in accordance BRC Guidelines Section 6 & Austroads Road Part 3 Section 3				
Drainage & flood constraints identified				
Services to be installed/moved located as required to suit road design with clearances				
Suitable road cross sections developed considering relevant design parameters in accordance with BRC Guidelines Section 6 & Austroads Road Part 3				
Batter slopes and stabilisation/remediation treatments detailed				
Accesses/driveways provided to all proposed/existing access points and can be used safely with appropriate sight distance in accordance with BRC Guidelines Section 6				
Accesses/driveways not located opposite intersections or within 6m of kerb return tangent point				
TfNSW supplements to Austroads guides reviewed & checked for discrepancies				
Design vehicles horizontal & vertical swept path clearances checked				
Glare protection for drivers/existing residences required				
Maintenance and emergency vehicles can stop without disrupting traffic flows				
Colour/texture of all pavements in road reserve considered for both day and night visibility				
Pavement (Austroads Guide to Pavement Design Part 2: Pavement Structural Design & BRC Engineering Guidelines)				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Geotechnical report showing soil test sites, bore logs, CBR values etc to accompany design plans				
Environmental considerations evaluation undertaken in accordance with Austroads Pavement Part 2 Section 4				
Subgrade evaluation undertaken in accordance with BRC Guidelines Section 6 & Austroads Pavement Part 2 Section 5				
Pavement materials determined in accordance with Austroads Pavement Part 2 Section 6				
Design traffic load determined in accordance with BRC Guidelines Section 6 & Austroads Pavement Part 2 Section 7				
Pavement design undertaken in accordance with Austroads Pavement Part 2				
Suitable pavement drainage detailed (subsoil or open drain/channel)				
Horizontal Geometry (Austroads Guide to Road Design Part 3: Geometric Design & BRC Engineering Guidelines)				
Tangents in accordance with Austroads Road Part 3 Section 7.3				
Curves in accordance with Austroads Road Part 3 Sections 7.4, 7.5 & 7.6				
Superelevation/cross fall in accordance with BRC Guidelines Section 6 & Austroads Road Part 3 Sections 7.7, 7.8 & 7.9				
Kerb return, knuckle and cul-de-sac minimum radius in accordance with BRC Guidelines Section 6 & Austroads Road Part 3 Section 7				
Vertical Geometry (Austroads Guide to Road Design Part 3: Geometric Design & BRC Engineering Guidelines)				
Vertical control considerations achieved in accordance with Austroads Road Part 3 Section 8.2				
Grades in accordance with BRC Guidelines Section & Austroads Road Part 3 Sections 8.3, 8.4 & 8.5 (Note: maximum 5% grade intersection through road and cul-de-sac turning heads, maximum 3% at intersection give way & stop signs)				
Curves in accordance with Austroads Road Part 3 Section 8.6				
Adequate vertical clearance to overhead structures				
Short curves used on sections of flat grade to prevent flat section in pavement/kerb				
Existing road grades matched at connection points				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Pedestrian sight distances assessed in addition to motorists				
Coordination of Horizontal & Vertical Geometry (Austroads Guide to Road Design Part 3: Geometric Design)				
Geometry coordinated in accordance with Austroads Road Part 3 Sections 6.1, 6.2, 6.3 & 6.4				
Conflicts with existing utility services resolved				
Auxiliary Lanes (Austroads Guide to Road Design Part 3: Geometric Design)				
Auxiliary lanes in accordance with Austroads Road Part 3 Section 9				
Intersections and Crossings (Austroads Guide to Road Design Part 4: Intersections and Crossings & Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections)				
Cross section controls in accordance with Austroads Road Part 4 Section 4.5				
Design vehicle considerations in accordance with Austroads Road Part 4 Section 5				
Public transport provisions in accordance with Austroads Road Part 4 Section 6				
Property access and median opening in accordance with Austroads Road Part 4 Section 7				
Pedestrian and cyclist crossings in accordance with Austroads Road Part 4 Sections 8 and 9				
Layout controls in accordance with Austroads Road Part 4A Section 2				
Sight distances achieved (including all accesses/driveways) in accordance with Austroads Road Part 4A Section 3				
Auxiliary lanes in accordance with Austroads Road Part 4A Section 5				
Traffic islands and medians in accordance with Austroads Road Part 4A Section 6				
Right and left turn treatments in accordance with Austroads Road Part 4A Sections 7 and 8				
Signalised intersections in accordance with Austroads Road Part 4A Section 9				
Design vehicles horizontal & vertical swept path clearances checked				
Motorists visually aware of intersection – medians, signage, linemarking etc detailed as required				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Assessment to determine if crash barrier/fencing for pedestrians is required				
Blisters/signage provided as required to prevent unsafe parking in vicinity of intersection				
Adequate vehicle storage space for turning movements provided				
Roundabouts (Austroads Guide to Road Design Part 4B: Roundabouts & BRC Engineering Guidelines)				
Sight distance achieved in accordance with Austroads Road Part 4B Section 3				
Geometric design in accordance with Austroads Road Part 4B Section 4				
Pedestrian and cyclist treatments in accordance with Austroads Road Part 4B Section 5				
Pavement marking in accordance with Austroads Road Part 4B Section 7				
Landscaping and street furniture in accordance with BRC Guidelines Section 6 & Austroads Road Part 4B Section 7				
Design vehicles horizontal & vertical swept path clearances checked				
Roadside Design, Safety and Barriers (Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers, Austroads Guide to Road Design Part 6B: Roadside Environment, AS 1158.1.2: Road Lighting, TfNSW QA Spec R132: Safety Barrier Systems & BRC Engineering Guidelines)				
Hazards within road reserve identified and treatment options assessed				
Hazard safety treatments designed in accordance with Austroads Road Part 6 Section 4				
Road safety barriers designed in accordance with Austroads Road Part 6 Section 5 & TfNSW R132				
Steep downgrades designed in accordance with Austroads Road Part 6 Section 6				
Roadside infrastructure in accordance with Austroads Roads Part 6B Section 4				
Lighting pole placement in accordance with AS 1158.1.2				
Landscaping design in accordance with relevant Austroads sight distance requirements & BRC Guidelines Section 6				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Road Signage and Pavement Marking (Austroads Guide to Traffic Management Part 10: Traffic Control and Communication Devices, AS 1742: Manual of uniform traffic control devices, AS 1428.1: Design for Access & Mobility, TfNSW Delineation Guide, TfNSW QA Spec R131: Guideposts, TfNSW QA Spec R142: Raised Pavement Markers, TfNSW QA Spec R143: Signposting, TfNSW QA Spec R145: Pavement Marking (Performance Based) & BRC Engineering Guidelines)				
Traffic signs required identified, located and specified in accordance with Austroads Traffic Part 10 Sections 4 and 5, AS 1742, TfNSW Delineation Guide & TfNSW R143				
Pavement markings and markers required identified, located and specified in accordance with Austroads Traffic Part 10 Section 6, AS 1428.1, TfNSW Delineation Guide, TfNSW R142 & TfNSW R145				
Tactile surface indicators provided for vision impaired motorists & pedestrians in accordance with AS 1428.4.1				
Painted traffic islands in accordance with Austroads Traffic Part 10 Section 9				
Guideposts and delineators in accordance with Austroads Traffic Part 10 Section 7 & TfNSW R131				
Street sign and roundabout signage in accordance with BRC Guidelines Section 6 & Standard Drawings EN7880 and EN10775				
Signs and linemarking not obscured by landscaping or structures				
Frangible road furniture provided where required				
Parking Facilities (Austroads Guide to Traffic Management Part 11: Parking, AS2890: Parking Facilities & AS 1158.3.1: Lighting for Roads and Public Spaces)				
Off-street parking in accordance with Austroads Traffic Part 11 Section 7 & AS 2890				
On-street parking in accordance with Austroads Traffic Part 11 Section 8 & AS 2890				
Rural parking in accordance with Austroads Traffic Part 11 Section 9 & AS 2890				
Parking guidance & control devices in accordance with Austroads Traffic Part 11 Section 11				
Parking lighting in accordance with AS 2890 & AS 1158.3.1				
Consideration given to electrical vehicle charging stations				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Paths for Walking and Cycling (Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling, AS 1428.1: Design for Access & Mobility & BRC Engineering Guidelines)				
Design requirements of Austroads Road Part 6A considered and minimum requirements met				
Design requirements of AS1428.1 considered, and minimum requirements met				
Perambulator ramps provided in accordance with BRC Guidelines & EN7877				
Footpath, cycleway & shared paths details meet minimum construction requirements of BRC Engineering Guidelines & EN7879				
Drainage (Australian Rainfall and Runoff & BRC Engineering Guidelines)				
Alignment is above 1% AEP flood level				
Arterial road alignments above 2% AEP event				
Pits provided at all road surface/kerb low points				
Subsoil drainage detailed along kerbs with outlets into stormwater network				
Table/dish drains located and depthed to allow drainage of pavement				
Pits provided at all changes in direction				
Pit spacing no greater than 85m				
Gutter flow width does not exceed 2.5m in design storm				
All pipes minimum 375mm diameter in road reserves				
Road can be become floodway in urban environment where required				
Overland flow paths provided at road low points in urban environments				
Soil & water management plans certified by CPSEC qualified persons provided				
No water ponding along road embankments				
STORMWATER DESIGN				
General (BRC Engineering Guidelines)				
Pits provided at all finished surface low points				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Stormwater infrastructure out of zone of influence of surrounding structures				
All stormwater infrastructure accessible for maintenance during adverse weather				
All specified pit lids square with reinforced lifting eyes				
Pits provided at all changes in direction and at spacings no greater than 85m				
Pits 1000mm or deeper specified with minimal internal dimensions of 900x900				
Pits 1200mm or deeper specified with step irons for access				
All pits (precast & in-situ) and their covers specified/designed to support design load class based on AS 3996, with an absolute minimum of class B for non-trafficable areas and class D for trafficable areas				
Kerb inlet pits located on common allotment boundaries and clear of horizontal curves, pedestrian travel routes, driveways and trees/vegetation				
Security grates provided to headwalls on trunk drainage systems in accordance with BRC Guidelines Section 7				
Standard kerb inlet pit lintel sizes used – 1.8, 2.4, 3.0 or 3.6m				
Minimum kerb inlet pit lintel size on sags 2.4m				
Only kerb inlet pits used within road reserve in accordance with EN12046				
Pipes crossing existing roads perpendicular where practicable				
Pipes beneath road pavements kept to a minimum				
Minimum pipe size 375mm in urban road reserves				
Minimum pipe size 450mm in rural road reserves				
No downstream pipes smaller than upstream pipes				
All pipes RRJ type				
Pipe materials in accordance with BRC Guidelines Section 7				
Pipe classes checked with PipeClass Software				
Pipe cover to finished surface minimum 600mm				
Pipe vertical clearance to other services minimum 150mm (including pipe collar)				
Pipe horizontal clearance to other services minimum 400mm (including pipe collar)				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Trench stops detailed for lines with grade greater than 6.5%				
Concrete bulkheads detailed for lines with grade greater than 10%				
Subsoil pipes specified 3m upstream from all pits				
Subsoil drainage provided to both sides all new pavements, draining at 1% to stormwater network				
Easements detailed & consent from downstream owners obtained				
Trunk drainage system located in existing water courses or drainage depressions				
All trunk/general drainage areas that require mowing maintenance suitably shaped/sloped				
Overland flow paths provided at road low points in urban environments				
Downhill cul-de-sacs provided with overland flow path				
Overland flow paths designed to minimise impact on private property				
Overland flow paths located to ensure safe vehicular and pedestrian movements				
Bridges and other major drainage structures above 1% AEP event plus 500mm freeboard				
Retarding basins designed for dual use where practicable				
Channel/basin batter slopes do not exceed 1:6				
Interallotment drainage provided to all allotments not fully draining to the road/trunk drainage network				
Interallotment drainage pits specified with a 100mm outlet spur pipe for reception of property roof drainage				
Interallotment drainage pipes located 1m off side/rear property boundaries				
Channel stabilisation measures detailed				
Culverts full width of road reserve in urban areas				
Flood warning signage specified adjacent to retarding basins/channels etc				
Minimum base width of grassed swales 2.5m				
Soil & water management plans certified by CPSEC qualified persons provided				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
EPA approval of soil & erosion management plans for subdivisions of more than 50 lots				
Batter drains provided in fills as required				
Top of pit levels and overall pit depth information carefully detailed based on finished surface levels				
Pipes extended to extremity of development to allow future connection with no disturbance to established areas				
Hydrology (Australian Rainfall & Runoff: A Guide to Flood Estimation, Austroads Guide to Road Design Parts 5, 5A and 5B & BRC Engineering Guidelines)				
Latest rainfall data obtained for modelling				
Trunk drainage network modelled using appropriate software in accordance with ARR				
Trunk drainage calculations calibrated against known discharge				
Trunk drainage impact assessed based on zero initial and continuing loss rates in accordance with ARR				
Trunk drainage channel design model based on fully developed future catchment/network				
All trunk drainage open channels provided/ designed/modelled with low flow pipeline to cater for 100% AEP event				
Retarding basins modelled with suitable reservoir runoff software and calibrated using unit hydrograph method				
Retarding basins designed to ensure that outflow will not interact with downstream flows and produce a peak flow rate greater than the system capacity				
Retarding basin backwater flows checked to ensure water does not back up onto roads during 1% AEP event				
Retarding basin spillways designed to pass 1% AEP and PMF events with no damage or failure				
Hydraulics (Australian Rainfall & Runoff: A Guide to Flood Estimation, Austroads Guide to Road Design Parts 5, 5A and 5B & BRC Engineering Guidelines)				
Downstream capacity of system is not exceeded with proposed works				
Minor system handles relevant AEP event				
Major system handles 1% AEP event (including freeboard) assuming the minor system is blocked with suitable overland flow paths and conduits				
All allotments and structures located a minimum of 500mm above the 1% AEP flood level				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Minimum pipe grade 1%				
All pipe flow velocities greater than 0.6m/s and less than 8m/s				
Flow velocities maintained through pits				
Drop through pits: • 50mm minimum when no change in direction or diameter • 70mm minimum when change in direction but no change in diameter • Changes in pipe diameter graded from obvert to obvert				
Kerb inlet pits spaced to restrict maximum gutter flow width to 2.5m				
Kerb inlet pit bypass flows limited to 15% of the gutter flow at that location				
Kerb inlets pits specified at the upstream kerb return at intersections where flows exceed 20l/s or gutter flow width is more than 1m				
Minimum clearance from top of pit to the design pit water level 150mm				
Product of flow velocity and depth of flow in the gutter does not exceed $0.4m^2/s$				
Pit inlet capacities estimated from design charts and formulae based on lintel size for on-grade pits and depth of ponding for sag pits. Calculated inlet capacity based on reducing this value by 50% for sag pits and 20% for on-grade pits				
Trunk drainage channels designed using backwater calculations with a 500mm freeboard above 1% AEP				
The product of trunk drainage velocity and depth does not exceed $1m^2/s$ in the 1% AEP event				
Trunk drainage channel centreline horizontal curves have radius not less than twice the 1% AEP surface flow width with an absolute minimum of 30m				
Trunk drainage mannings roughness values in accordance with BRC Guidelines Section 7				
Low flow pipes minimum 450mm diameter and minimum 1% grade				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Road and interallotment drainage connected to low flow system using surcharge pits				
Grass-lined channels design Froude number less than 0.8				
Maximum velocity in trunk drainage channels 2m/s in the 5% AEP event				
Channel base crossfall a minimum of 2% with a depressed invert				
Overland flow paths cater for 1% AEP event with overtopping assuming minor system blocked				
Roads acting as overland flow paths in 1% AEP event have maximum catchment area of 20-30hectares and designed for a peak flow of 2.5m^3/s with the product of velocity and depth not exceeding 0.4m^2/s				
Gutter flows on roads acting as overland flow paths have maximum width of 2m and 125mm depth				
Retarding basins designed for 1% AEP event with 500mm freeboard and consideration given to probable maximum event				
Spillways and connecting overland flow paths detailed for retarding basins				
Retarding basins have minimum base slope of 1%				
Retarding basins include low flow drainage system where used for recreation purposes				
Retarding basins designed for a maximum depth of 1.2m for 5% AEP event				
Impact of headwater and backwater assessed				
Height and energy level of downstream system assessed				
Uncontrolled overland flow avoided				
WATER DESIGN				
General (BRC Engineering Guidelines)				
Pipes sized according to demand flow from hydraulic assessment, with absolute minimum 100mm diameter in residential areas and 150mm in commercial and industrial areas				
Pipe materials in accordance with BRC Guidelines Section 8				
Fittings detailed in accordance with BRC Guidelines Section 8				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Service connections provided to all allotments, parks, reserves and roundabouts in accordance with EN7906 and BRC Guidelines Section 8				
Polyethylene sleeving in accordance with BRC Guidelines Section 8				
Water meters detailed in accordance with EN7906 and BRC Guidelines Section 8				
Thrust blocks detailed in accordance with EN7905 and BRC Guidelines Section 8				
Covers, indicator posts and markers detailed in accordance with EN7907 and BRC Guidelines Section 8				
Hydrants provided at spacings no greater than 90m in residential areas and 60m in commercial and industrial areas in accordance with BRC Guidelines Section 8				
Stop valves provided in accordance with BRC Guidelines Section 8				
Scour valves provided at all low points in water mains and outlet through a legal point of discharge with stabilised outlets in accordance with the NSW Blue Book				
Mains extended through cul-de-sacs in accordance with EN7908 and BRC Guidelines Section 8				
Pipe cover to finished surface minimum 800mm				
Mains located in accordance with EN7885 and EN12046				
Mains extended to extremity of development to allow future connection with no disturbance to established areas				
Mains provided on both sides of road in commercial and industrial developments				
Telemetry detailed in accordance with BRC Guidelines Section 8				
Water infrastructure out of zone of influence of surrounding structures				
Water infrastructure accessible for maintenance during adverse weather				
Layout & design approved by water section				
Easements detailed				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Hydraulics (Water Services Association of Australia Standards (WSAA), Public Works Advisory NSW Standards & BRC Engineering Guidelines)				
Hydraulics design undertaken by suitably qualified persons and calculations provided				
Design water demands calculated in accordance with WSAA and/or Public Works Advisory NSW standards				
Service reservoirs minimum capacity one day's supply at peak demand				
Main to provide minimum static head to each allotment of 30m when the reservoir is at two thirds capacity				
Main to provide minimum head to each allotment of 15m at peak instantaneous demand when measured at property meter when reservoir is at one third capacity				
SEWER DESIGN				
General (BRC Engineering Guidelines)				
Pipes sized according to design flows from hydraulic assessment in accordance with BRC Guidelines Section 9				
Pipe materials in accordance with BRC Guidelines Section 9				
Junctions provided to all allotments & parks in accordance with EN7900, EN11576 and BRC Guidelines Section 9				
Polyethylene sleeving in accordance with BRC Guidelines Section 9				
Manholes detailed in accordance with EN7898 and BRC Guidelines Section 9				
Manhole cover levels adjusted to be flush or above finished surface levels in accordance with EN7898				
Minimum and maximum grades in accordance with BRC Guidelines Section 9				
Minimum cover in accordance with BRC Guidelines Section 9				
Sidelines in accordance with BRC Guidelines Section 9				
Any proposed structure over sewer infrastructure in accordance with BRC Guidelines Section 9				
Septic systems in accordance with BRC Guidelines Section 9				
Sewer infrastructure out of zone of influence of surrounding structures				

Description	Yes	No	N/A	Comments/Outcome/Details/Reasons for Non-Compliance
Location and clearance of/to mains in accordance with BRC Guidelines Section 9				
Rising mains detailed in accordance with BRC Guidelines Section 9				
Thrust blocks designed and suitably detailed				
Mains extended to extremity of development to allow future connection with no disturbance to established areas				
Telemetry detailed in accordance with BRC Guidelines Section 9				
Sewer infrastructure accessible for maintenance during adverse weather				
Layout & design approved by sewer section				
Easements detailed in accordance with BRC Guidelines Section 9				
Top of pit levels and overall pit depth information carefully detailed based on finished surface levels including manhole cover finishing above surfaces as required by EN7898				
Hydraulics (Water Services Association of Australia Standards (WSAA), Public Works Advisory NSW Standards & BRC Engineering Guidelines)				
Hydraulics design undertaken by suitably qualified persons and calculations provided				
Design sewer flows calculated in accordance with WSAA and/or Public Works Advisory NSW standards				
Pump stations designed in accordance with BRC Guidelines Section 9				

APPENDIX C - B.R.C. ENGINEERING DRAFTING CHECKLIST

To be completed by relevant Design Engineers and Surveyors (word version can be supplied on request)

Description	Yes	No	N/A	Comments/Variations/Details
GENERAL				
Schedule showing the date and description of all amendments provided				
Bar scales shown on plans				
Consultants detail shown on plans				
Locality plan provided				
Limit of works/staging details detailed				
Easements & rights carriageway detailed				
All job specific typical cross sections, profiles & details included				
Alignment chainage labels displayed match chainages provided on longsections, cross sections and setout details				
Road pavement details provided				
Survey coordinate system and height datum specified (e.g. GDA2020 AHD)				
Survey control marks detailed including coordinates				
Design speed details provided				
All coordinates in tables to 3 decimal places				
Contours and contour labels shown on appropriate sheets with notes stating contour intervals				
All allotment slopes detailed with slope arrows				
Northpoint shown adjacent to all viewports/layouts				
Northpoint direction above horizontal for all viewports				
Heading with plan description & scale shown for all viewports/layouts				
Proposed service pit & kerb return markers shown on appropriate sheets				
Road names shown on appropriate sheets				
Lot & DP numbers shown on appropriate sheets				
Chainages shown on appropriate sheets				
Viewports/layouts set to a standard scale				

Description	Yes	No	N/A	Comments/Variations/Details
Legend provided including symbols				
Aerial imagery used only on appropriate sheets				
Coloured linework & hatching used only on appropriate sheets				
All plans (including linework, text etc.) distinguishable & readable				
Existing/future linework clearly distinguished from proposed linework				
ROADS/DESIGN STRINGS/PROFILE STRINGS				
Road plans include chainage, bearing, tangent point, curve radii, spiral length & deflection angle details and show finished surface level contours & labels				
Location and details of all road furniture, devices & pavements markings provided				
Location and details of all kerb laybacks, driveways, perambulator crossings, footpaths, cycleways and driveways provided				
Locations and details of all road service crossings provided				
Longsections and cross sections plotted to standard scale with 5:1, 2:1 or 1:1 vertical exaggeration				
Longsections annotated with heading stating design string, code and scales				
Longsections include cut/fill, design level, existing level, chainage, vertical curve information				
Cross sections annotated with heading stating design string and scales				
Cross sections include chainage, design code, cut/fill, design level, existing level & offset information				
Longsections low & high points annotated				
Crossfalls & slopes displayed as required on cross sections				
Appropriate linework deleted at intersections between kerb returns on cross sections				
All service crossings shown & annotated with a dashed line & note on longsections and cross sections				
Structures shown (culverts, bridges, guardrail etc) on longsections and cross sections				

Description	Yes	No	N/A	Comments/Variations/Details
Intersecting streets annotated with dashed line & note on longsections				
Extent of works markers used where applicable				
Road alignment labels shown on appropriate sheets				
STORMWATER				
Longsections include flow, velocity, pipe material, pipe size, grade, depth to invert, invert level, finished surface level and chainage details				
Longsections plotted to standard scale with 5:1, 2:1 or 1:1 vertical exaggeration				
All service crossings shown & annotated with a dashed line & note on longsections				
Overall layout plan showing all stormwater pits/lines with pit labels provided				
All stormwater viewports maintain same orientation/rotation for readability				
Line labelling increases sequentially for each line upstream				
Pit labelling increases sequentially from downstream to upstream				
Longsections plotted with downstream point to the left of page				
Catchments sheet provided for development works and show location of existing surface drainage				
Hydraulic calculations provided for relevant major and minor events				
WATER				
Overall layout plan showing all water works provided				
All water viewports maintain same orientation/rotation for readability				
Materials list table detailing all water materials quantities provided				
All valves, hydrants and horizontal/vertical bends labelled				

Description	Yes	No	N/A	Comments/Variations/Details
SEWER				
Longsections include pipe material, pipe size, grade, depth to invert, invert level, finished surface level and chainage details				
Longsections plotted to standard scale at 5:1, 2:1 or 1:1 vertical exaggeration				
All service crossings shown & annotated with a dashed line & note on longsections				
Overall layout plan showing all sewer pits/lines with pit labels provided				
All sewer viewports/layouts maintain same orientation/rotation for readability				
Line labelling increases sequentially for each line upstream				
Pit labelling increases sequentially from downstream to upstream				
Longsections plotted with downstream point to the left of page				
All junctions distance from downstream manhole labelled				

Signed .....

Name .....

Address .....

STANDARD DRAWINGS

Item	Title	Drawing Number	Number of Sheets
1	Kerb & Gutter & Layback Details	EN7876	1
2	Perambulator Crossing Details	EN7877	1
3	Street Intersection Median Island	EN7878	1
4	Concrete Footpath, Cycleway & Shared Path Details	EN7879	1
5	Street Sign Details	EN7880	1
6	Rural Access & Standard Concrete Drain Details	EN7881	1
7	Urban Access Details	EN7882	2
8	Trench Shielding Requirements	EN7883	1
9	Urban Road Verge Allocation Details Pre-September 2023	EN7885	1
10	Kerb Inlet Pit Details	EN7886	2
11	Junction Pit Details	EN7887	1
12	Surface Inlet/Surcharge Pit Details	EN7888	1
13	Interallotment Pit Details	EN7889	1
14	Penstock Pit Details	EN7890	1
15	Interallotment Pit in Concrete Path Details	EN7891	1
16	Stormwater Pipe Bedding & Backfill Details	EN7892	1
17	Kerb Inlet Pit Deflector Design	EN7893	1
18	Building Stormwater Footpath/Verge Conversion Details	EN7894	1
19	Pipe Restraint & Concrete Bulkhead Details	EN7895	1
20	Subsoil Drainage Details	EN7896	1
21	Subsoil Drain Flushout Point & Outlet Details	EN7897	1
22	Sewer Manhole Details	EN7898	1
23	Sewer Junction Details	EN7900	1
24	Sewer Pipe Bedding & Backfill Details	EN7901	1
25	Zone of Influence Diagram & Pipe Concrete Encasement Details	EN7902	1
26	Water Hydrant & Valve Details	EN7903	1
27	Water Pipe Bedding & Backfill Details	EN7904	1
28	Water Thrust Block & Anchorage Details	EN7905	1
29	Water Service Crossing & Meter Connection Details	EN7906	1
30	Water Covers, Indicator Posts & Markers Details	EN7907	1
31	Water Reticulation Layout for Cul-de-sacs	EN7908	1
32	Floodway within Footpath Details	EN9161	1
33	Roundabout Landscaping and Sight Distance	EN10775	1
34	Sewer Main Encasement for Junction Cut-In Works Details	EN11576	1
35	Regular Tree Planting Details	EN12014	1

36	Passively Irrigated Street Tree Planting Details	EN12045	3
37	Urban Road Typical Layout & Verge Details in Greenfield Sites from 21 September 2023	EN12046	11
38	Earthworks Details at Subdivision & Dwelling Stages	EN12047	7
39	Open Space Vehicle Barrier & Access Details	EN12050	1
40	Water Main Pressure Reduction Valve Details	EN12076	1