

**DESIGN SPECIFICATION
2016**

**REVISION A
JULY 2022**



Wollondilly Shire Council

SUBDIVISION & ENGINEERING STANDARD



AUS-SPEC #1

Development Specification Series

PREFACE

Since the adoption of the 2016 Design Specification, there has been significant changes to development control documentation. Recently Council has seen the adoption of an Integrated Stormwater Management Policy, and supporting guidelines, and the development of the Western Sydney Street Design Guidelines. These documents provide an important step forward in minimising the impact on the environment and in providing public infrastructure that better supports the community.

Wollondilly Shire Council will be undertaking a major review of its Design and Construction specification in the 2022-2023 year. This review will be looking at ways we can improve the delivery and relevance of information for development standards. This may include the development of online specifications or the adoption of the Western Sydney Engineering Design Manual prepared by the Western Sydney Planning Partnership.

In the meantime, this 2016 revision aims to incorporate the key changes to Council policy relating to development and environmental management. Other minor changes aim to simplify design requirements.

Design Specification Contents

Section	Title
DQS	Submission Requirements for Engineering Design
D01	Geometric Road Design (Urban and Rural)
D02	Pavement Design
D03	Structures / Bridge Design
D04	Subsurface Drainage Design
D05	Stormwater Drainage Design
D06	Site Regrading
D09	Cycleway and Shared Pathway Design
D10	Bushfire Protection
D13	Access and Off-street Parking

DESIGN
SPECIFICATION

DQS

**SUBMISSION REQUIREMENTS
FOR ENGINEERING DESIGN**

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New text is shown underlined and deleted text shown struck through (eg. or as 'DELETED'). New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Certification by qualified engineer	DQS.04	A	DC	1/07/22
2	Flood planning levels	DQS.10	A	DC	1/07/22
3	Basin capacity	DQS-A	A	DC	1/07/22

**DQS : SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN
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DQS : SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

DQS.01 SCOPE

1. This design specification sets out the minimum submission requirements of Designs required by Council for development consents.

DQS.02 OBJECTIVES

1. This specification aims to set standards and document requirements for the execution and recording of design processes in order that the infrastructure associated with any development is designed to be fit for service and where applicable, be of a standard reasonably maintainable when it is accepted by Council as a community asset.

Maintenance

2. It is also an objective that these qualities be readily demonstrable by clear records of key design processes and that data relevant to the upkeep of the assets is available to Council's management.

Records

3. One of the key deliverables is the need for a common standard for design information and for work as constructed information. The ADAC (Asset Design & As Constructed) has been developed by IPWEA. It has become a widely accepted standard. Council has adopted ADAC as a specification to assist with the orderly creation of asset information and the recording of that information in corporate databases and systems. This information is used as Council's record of what exists in the field and is used as a record of the location for asset control. It is crucial to the operation of Council that these records are an accurate record of what the Council owns.

ADAC

Please check the ADAC website for the current versions of the ADAC schema and help files. Details can also be found in Council's Guidelines for the Submission and Creation of ADAC .xml files.

DQS.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

All Specifications for Design and Construction
Council's Guidelines for the Submission and Creation of ADAC .xml files
Councils As Constructed Data Templates
Council's Codes and Policies

(b) Australian Standards

AS/NZS 3905.2	Guide to quality system Standards AS/NZS 9001, AS/NZS 9002 and AS/NZS 9003 for construction.
AS/NZS 3913	Quality manuals – Guide to preparation.
AS/NZS ISO 8402	Quality management and quality assurance – Vocabulary.
AS/NZS ISO 9001	Quality systems – Model for quality assurance in design, development, production, installation and servicing.
AS/NZS ISO 9004.1	Quality management and quality system elements – Guidelines.

(c) Other

Section 90 (EP&A ACT)
Local Government Act (1919) Subdivisions Pt XII
Local Government Act (1993)
Technical Publications used as Engineering Standards (AR&R)
Interim Policies and Guidelines

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

DQS.04 CERTIFICATION

1. The Developer shall present all engineering plans to the Principal Certifying Authority for acceptance. Each set of plans shall be accompanied by a Certification Report which will be signed by the Developer's Engineer or Quantity Surveyor. The Certification Report will comprise the certificate and check lists set out in Annexure DQS-A. Approval of the plans by the Principal Certifying Authority does not relieve the developer from rectifying any errors or omissions that become evident during construction.

Certification Report

2. Certification Reports shall be required with preliminary plans and shall require resubmission with updates when final plans are submitted. Concept plans for proposed engineering work must be prepared or endorsed by suitably qualified persons as outlined in DQS.06 below. Certification Reports are not required with sketch plans or concept plans.

Certification of Preliminary and Concept Plans

3. The Certification Report shall indicate on check lists any aspects of design which do not meet requirements or tolerances set out in Council's Design and Construction Specifications and Council Codes.

4. The design and construction of bioretention basins, bridges and retaining walls must be certified by a suitably qualified structural/civil engineer.

DQS.05 MINIMUM DRAFTING REQUIREMENTS

1. Design plans shall be definitive and clearly set out so as to present the design concepts in such a way that the project can be understood, specified for construction and satisfactorily built.

2. All design plans should be clearly numbered by the designer with separate sheets numbered as part of a set. All drawing sheets shall have an allocated space in the bottom right hand corner for an assigned number provided by Council (18 characters).

Plan Numbers

3. The information shown on the drawings shall be logically collected on discrete sheets to avoid illogical and onerous effort in cross referencing between sheets in order to find information. Sheets of drawings should not be overcrowded with information and should not rely on colour printing or colour wash to impart information. Drawings should be on A1 size sheets and shall be on A1 sheets if they detail any work that will be owned by Council. The drawings should be suitable for black and white copying, microfilming and photo reduction to A3 paper size without loss of clarity.

Logical Drawing Sheets

4. Council has the authority to refuse plans that do not meet minimum drafting requirements. Plans copied from other works will not be accepted.

DQS.06 DESIGNER'S QUALIFICATIONS

1. A Civil Engineer suitably experienced and qualified so as to be accepted as a member of the Institution of Engineers, Australia or a suitably experienced Registered Surveyor shall be accepted as qualified to prepare plans for roadworks, drainage works, canal works (excluding flood control structures and bridges).

Engineer Surveyor

2. A Civil Engineer qualified as detailed above shall be accepted as qualified to prepare plans for bridges, retaining walls, miscellaneous structures, buildings, pumping stations and flood control structures.

Structural Design by Engineer

3. All hydraulic and hydrological calculations shall be carried out by a person experienced in hydrologic and hydraulic design.

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

DQS.07 RECORDS

1. The Designer shall retain appropriate design records in a format such that they can be understood readily by design staff with no prior knowledge of the particular design.

2. Calculations which can readily be re-done need not be kept once the construction maintenance period of the project has expired.

**Calculation
Record
Retention**

3. A design file shall be maintained by the Subdivider or his/her consultant containing records of calculations, approvals and decisions, geotechnical data and other design data which could be relevant in reviewing aspects of the design or planning future maintenance responsibilities.

**Design File to
be kept**

DQS.08 AUDIT

1. Council shall have the right of audit of all processes and documents related to the project design. The Developer and the Developer's Consultant shall provide Council's Officers all reasonable assistance in inspecting records of designs submitted to Council for acceptance.

Assistance

2. In order to provide for such audit, access to the premises of the Developer or the Developer's Consultant will be provided to Council on a 24 hour notice basis.

Access

DSQ.09 ADAC

1 The ADAC (www.adac.com.au) product is developed and maintained by a consortium of local government, utility and industry agencies in conjunction with IPWEAQ. It is becoming more recognised nationally. The ADAC XML format (Schema) is used to facilitate the collection, lodgement and retrieval of detailed asset information on contributed civil infrastructure and associated assets. Such asset data is essential to the efficient operation of the Council as it underpins a range of financial, spatial, operational and asset management systems which aid in the delivery of service outcomes.

General

Detailed instructions in the compilation of ADAC .xml files can be found in Council's "Guidelines for the Submission of ADAC .xml Files".

The ADAC schema is a non-proprietary data specification and transport mechanism written in the XML language that is used to define infrastructure in terms of fields and records associated with infrastructure objects. This common language facilitates the capture and transmission of detailed data on new civil infrastructure assets including water, sewerage, drainage, roads and open space as well as survey-accurate cadastral information.

In simple terms, the ADAC schema provides an efficient mechanism for the checking and validation of design and as constructed information submitted to Council. The ADAC schema also facilitates the application of individual business "rules" which can support data migration from the generic AutoCAD DWG or XML format into each "business" specific IT application.

2 All developers, contractors and contributors are required to undertake suitable steps to prepare or convert as constructed information to an XML file in accordance with the ADAC specifications data schema. This file is a key component of the asset information requirements of Council and is a prerequisite for obtaining a construction certificate.

**ADAC Data
File**

The ADAC data file must only be generated from accurate survey information as this data is imported into Council's Geographical Information System (GIS) and Asset Management

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

System (AMS). Survey information supporting the development of the ADAC data file must be provided by a licensed surveyor.

**ADAC Data
File
Coordinate
System**

3 All geometric features in the ADAC XML file and CAD drawings will be defined in Map Grid of Australia (MGA Zone 56 – GDA 94) coordinates. As-constructed data must be derived from at least two relatively well-spaced permanent survey marks with Map Grid of Australia (MGA Zone 56 – GDA 94) coordinates. Survey must be on true MGA not based on DCDB coordinates. Vertical datum must be AHD. Cadastre will be survey accurately based on registered plan data.

4 Detailed instructions in the compilation of ADAC .xml files can be found in Council's Guidelines for the Submission of ADAC .xml Files. The ADAC schema is regularly revised and users of this document need to go to the ADAC website (www.engicom.com.au/products/adac/) to get the current version of the schema.

**ADAC Data
collection
Coordinates
System**

5 For smaller developments, Council's As Constructed Data Template file in Microsoft Excel format can be utilised to submit as constructed asset data. The As Constructed Data Template file is manually populated based on the same guidelines as can be found in Council's Guidelines for Creation and Submission of ADAC .xml files.

**Alternative
ADAC
Submission for
small
developments**

DSQ.10 SUBMISSION REQUIREMENTS

**Alternative
ADAC
submission for
small
developments**

1 Plans for all proposed work associated with the development must be submitted to the Principal Certifying Authority for approval.

2 A typical example* of the sequence and scales of drawing sheets acceptable to Council in the compilation of a full set of subdivision plans is set out as follows.

**Subdivision
Plan Sheets**

- Title, Development Consent Number, Locality Sketch, site/staging plan (1:1000) and Index of Sheets.
 - General Subdivision Layout Plan including lot boundaries, drainage, existing services, existing and proposed contour details, cut/fill areas and batters and a clear indication of the extent of work. (1:500)
 - Intersection/roundabout plans with contour details and kerb profiles. (1:200)
 - Road Longitudinal Sections. (1:500h 1:100v)
 - Typical Road Cross Sections showing road widths, pavement configuration, batter slopes, kerb and gutter types.
 - Road Cross Sections
 - Drainage Catchment Plan (1:1000 or 1:2000) and Drainage Schedule.
 - Drainage Long sections (1:500h 1:100v).
 - Drainage calculations
 - Linemarking, pavement marking and signposting plan (1:200).
 - Specific earthworks plan if required (1:500).
 - Erosion and Sedimentation Control Plans (1:500).
 - Traffic Management Plan
- A set of Roadworks Plans may require more than 1 sheet for each of the topics listed and may also require supplementary sheets for site specific details. Scale must be shown on all applicable drawings.

3 Where construction of vehicular access to lots is required as part of the subdivision, details of the crossing location and internal driveway shall be shown.

4 Engineering plans in support of a construction certificate for Building work on a property must show:

**Property
Development**

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

- Details of the lot including lot boundaries, site levels/contours, existing vegetation and natural features
- All existing and proposed buildings and structures on the property
- All existing and proposed property accesses, internal driveways, loading areas and carparking provisions
- Drainage Plans and Calculations

(a) Roads - (Public and Private)

1 Layout plans are to be reduced to 1:500 or any other suitable standard scale as agreed by Council and should show the following:

Layout Plans

- Boundaries of road reserves, pathways, public reserves, lots and easements (both existing and proposed) in relation to road chainages.
- Road, accessway and pathway numbers or names.
- Existing contours, spot levels and final surface contours (maximum contour interval 0.5 metres) to Australian Height Datum.
- Natural features such as cliffs, watercourses, swamps, dams, ditches.
- Existing constructed features including building structures, retaining walls, fences, kerb and gutter, road pavement, pipes, pits.
- Limit of works.
- Road chainage pegs and other survey lines and sections.
- Schedule of symbols and notation of items e.g. kerb & gutter, pits, pipes.
- Kerb and Gutter alignment and concrete footpaving.
- Existing and proposed drainage lines and structures suitably numbered and location chainages
- Details and Schedule of subsoil drainage lines.
- Notation regarding provision of guide posts and guard rails.
- Road centreline bearing and radii, kerb return and cul-de-sac kerb alignment radii.
- Tangent points to curves.
- The location and level of all existing utility services with construction notes relating to any necessary alterations.
- Pavement construction details, surfacing detail, pipe types and classes, drainage structure and kerb types, concrete strengths, pipe bedding types.
- Footpath and carriageway widths.
- Location of any traffic calming devices eg. Entrance thresholds, roundabouts, speed humps etc.
- Location of existing and proposed access to each allotment.
- Site regrading areas.
- Extent of cut and fill batters of significance.
- Significant vegetation.
- Location of bus stop construction.
- Kerb return numbers.
- Proposed service crossings.
- North point.
- Location of passing and parking bays.

2 Longitudinal section of the centreline of roads shall be drawn at a scale of 1:100 Vertical, and 1:500 Horizontal or any other suitable standard scale as agreed by Council. The longitudinal section should show:

Longitudinal Sections

- Chainages running left to right across the page.
- Reduced levels of existing surface.
- Design level of road.
- Design grades and lengths of vertical curves.
- Chainage and reduced levels for each intersection point.
- Chainage at intersection with other roads.
- The chainage and level of each crest and sag point.
- Position and level of culverts, drainage lines and public utility mains.
- Longitudinal levels should be taken at maximum 20 metre intervals and at all intermediate changes of grade.

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3 Cross sections should be drawn at a scale 1:200 or any other suitable standard scale as agreed by Council at intervals not less than 10 metres and not greater than 20 metres. In addition, cross sections should be drawn at sag points, tangent points, transition points and culvert points. Cross sections should be leveled at least 10 metres beyond the property alignment to enable batters of cutting and embankments to be shown. Cross sections should show:

Road Cross Sections

- Road centreline chainages below each section.
- Offset chainage from the pegged centreline.
- Reduced levels of existing surface.
- Design levels of pavement, kerb and gutter and footpath.
- The position size and level of any public utility, mains and services affecting the work.
- Existing and proposed road reserve boundaries.

A typical cross section is to be included at a scale of 1:100 or any other suitable standard scale as agreed by Council showing the following information:

- Footpath and carriageway widths
- Crossfalls
- Pegged Centrelines
- Kerb types
- Kerb lines
- Boundary lines
- Typical batter slopes for cut and fill
- Levels and offsets relative to the centreline
- Depth and type of material to be used for each layer of pavement
- Type of surfacing
- Sub-soil drainage.

4 Where a proposed road makes a junction with an existing road, longitudinal and cross sections extending at least 50 metres either side of the centreline intersection point of the existing road should be submitted. The cross sections are to include sections at the tangent points and the kerb returns.

5 Where it is proposed to replace an existing table drain with kerb and gutter, plan and long-section details shall be presented upstream and downstream of the work, for at least 20 metres showing:

- Existing ground levels along the table drain
- Finished ground levels of the table drain
- The extent of any proposed regrading of the footway

6 A contour plan at a scale of 1:200 or any other suitable standard scale as agreed by Council should be provided showing the finished level at all intersections, cul-de-sacs, bulbs and turning heads. The plans should include the following:

Intersection, Cul-de-sac Turning head Plans

- Reference points corresponding with points shown on the kerb return profile
- Contours at a minimum 0.1 metre interval
- Kerb return and centreline chainages
- Radii of kerb returns
- Tangent points identified by chainage
- Location of drainage pits and other structures.

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

7 Kerb profiles should be provided for all kerb returns and cul-de-sac bulbs at a scale of 1:200 horizontal and 1:20 vertical or any other suitable standard scale as agreed by Council. Each profile should have a kerb return number corresponding with a number shown on the plan view. The profile should represent the view as looking from the road to the face of kerb. Each plan should include the following:

Kerb Return Profiles

- Chainage: both the running chainage related to the profile together with the chainage related to the centreline.
- RL of the design top of kerb
- RL of the existing top of kerb
- Gradings and vertical curves
- Position of gully pits
- The applicable road name/number leading into the profile
- An extension of a minimum of 15 metres beyond the tangent points to ensure a smooth profile is practicable.

8 A plan should be provided at a scale of 1:200 or any other suitable standard scale as agreed by Council that shows the location of all street furnishing such as:

Street Furnishing Plan

- Linemarking,
- Street, speed, warning and regulatory signs,
- Guideposts,
- Safety barriers
- Feature walls.

9 The plans should show details of all structures such as Bridges, Causeways, retaining structures, feature walls and safety barriers.

10 A pavement design report shall be approved by the Principal Certifying Authority and shall detail all considerations, assumptions, subgrade test results and calculations used to determine the pavement design.

Pavement Design Report

11 The proposed location of all subsurface drains shall be clearly indicated on the Design Drawings, including the nominal depth and width of the trench, and the location with respect to the line of the kerb/gutter or edge of pavement. Where practicable, the location of outlets and cleanouts shall also be indicated on the Drawings. Assumptions and/or calculations made in the determination of the need or otherwise for subsurface drainage in special circumstances or as a variation to the requirements of the Design Specification DS 4 SUBSURFACE DRAINAGE DESIGN shall be submitted for approval with the Design Drawings.

Sub-surface Drainage

(b) Driveways and Accessways

1 Plans for driveways and access roads for properties shall show the following:

- The layout of all driveways and carparking spaces
- Dimensions of driveways and parking spaces
- Existing gutter levels along the property frontage at the location of the property entrance
- Finished levels along the driveway and levels of all parking spaces
- Pavement construction details.

(c) Drainage – Road, Trunk and Inter-allotment Drainage

1 Drainage design details for road, trunk and inter-allotment drainage should include a catchment plan, drainage layout plan, longitudinal section of pipes and open channels, cross sections of open channels and major overland flow paths and details of drainage structures.

Drainage Plans

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

2 The catchment plans shall be drawn at scales of 1:1000 or 1:2000 or any other suitable standard scale as agreed by Council and shall show:

Catchment Plans

Contours and contour values

- Direction of grading of kerb and gutter
- General layout of the drainage system with pit locations
- Catchment limits and Sub-catchment boundaries.

3 The drainage layout plan shall be incorporated into the road layout plans and shall show:

Drainage Layout Plans

- Existing and proposed drainage lines (including inter-allotment drainage) identified with line numbers, pipe diameters, pipe classes and grades.
- All drainage pits and other drainage structures identified by number and located by centreline road chainage
- Limits of open channels, inlet and outlet drains
- Schedule of drainage structures including type, size cover/lid description and identification number
- The location of any public utility services crossing influenced by the work
- All significant vegetation
- Overland flow paths for storms up to the 1% AEP (1 in 100 year ARI).

4 The drainage system longitudinal sections shall be plotted so chainages run left to right across the sheet starting at the upstream end of the system and shall be drawn to a scale of 1:500 horizontal and 1:50 vertically or any other suitable standard scale as agreed by Council and shall show:

Drainage Long sections

- Running chainages along the drainage line together with road centre line chainages where applicable
- Reduced levels to AHD of natural surface and finished surface levels
- Invert levels of any existing drains
- Design invert level and grade of pipelines, open drains, channels and watercourses
- Invert levels at pit inlet and outlet
- Pipe diameter, type and class.
- Capacity, design discharge flow and velocity
- Hydraulic grade line
- The accurate position and level of any proposed or existing utility services in the vicinity of the pipeline
- Drainage structures
- The water level in open channels during the design storm event
- The depth x velocity product in open channels.

5 Open channel and major overflow path cross sections shall be drawn at a scale of 1:100 natural or any other suitable standard scale as agreed by Council and shall show the direction in which the cross section should be viewed. The cross sections should be at a maximum of 30 metre intervals and should detail obstructions such as fences, buildings, embankments etc that may effect flows. General survey information is to be provided for a minimum of 50 metres upstream and downstream of the work.

Cross Sections

6 Special details including non-standard pits, pit benching, open channel designs and transitions, outflow headwalls and energy dissipaters shall be provided on the design drawings at scales appropriate to the type and complexity of the detail being shown.

7 A copy of the Hydrological and Hydraulic summary sheets providing the minimum information set out in the sample summary sheets for Hydrological and Hydraulic calculations given in the appendix, shall be incorporated into the drawings.

Calculations

8 The nine basic parameters read from Maps 1-9 in Volume 2 of ARR 1987 shall be shown in the calculations submitted to Council, except where The Bureau of Meteorology provides polynomial relationships for the catchment.

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

9 Where hydrological and/or hydraulic computer analysis programs are used, copies of the final data files shall be provided.

(d) Drainage – Property Drainage Systems

1 Drainage plans for property drainage systems, reduced to 1:100 scale or any other suitable standard scale as agreed by Council shall detail:

**Drainage
Layout Plans**

- The location of all buildings, driveways and impervious surfaces
- The location, trunk diameter and canopy size of any significant trees that may have roots that will be affected by the drainage system, whether they are on the subject property or not
- The location of all downpipes, surface channels, kerbs, pits and pipes
- The size and class of all pipes and the size of all pits
- The invert levels of all pipes and pits
- Finished surface levels of all pits
- Finished levels of any catch drains or swales
- Finished levels of all paved areas, unpaved areas, building floor levels and garage floor levels
- Contours at ½ metre intervals of the existing ground levels
- An indication of the path taken by overland flow during storm events where the capacity of the piped drainage system is exceeded
- Cross section details of any swales or catch drains proposed
- A clear indication of the location of any easements; the location size and depth of any Council or inter-allotment drainage pipelines; and the location of any watercourses passing through the property
- Any existing buildings or hard paving on the property not being removed as a consequence of the development, and the size and location of all drainage pipes and pits associated with the existing site improvements
- Details of the connection to Council's drainage system;
- If disposal is to the kerb, show the location and level at the point of discharge to the kerb
- If connection is to a Council or inter-allotment drainage pit, show location, size, invert level and surface level of the pit along with the location and size of all pipes entering and leaving the pit
- If connection is through a slope junction to a Council or inter-allotment pipeline, show the location, size and level of the pipe at the connection, invert and surface levels or pits upstream and downstream of the point of connection and a 1:20 scale detail of the manner of connection
- If discharge to a natural watercourse, show the location and level of the top and base of the creek banks, levels along the creek bed and a 1:20 scale detail of the outlet structure.

2 The layout plan or a separate catchment plan should indicate the limit and size of the catchment draining to each collection point.

3 If the property is affected by stormwater runoff from upstream properties, plans of the catchment area shall be provided. The catchment plan shall show contours and contour values, catchment boundaries, the catchment size, the anticipated runoff and a clear indication of where this runoff will enter the subject property.

**Catchment
Plans**

4 The following calculations are to accompany the layout plan:

Calculations

- calculation sheets detailing the area and surface type of the subcatchment for each collection point
- calculations to show the capacity of any swale or catch drain
- hydraulic grade line analysis of all pipelines in excess of 225mm \varnothing including pipe friction coefficients and shock loss coefficients used.

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(e) Construction Notes

1 The Design Drawings shall include construction notes covering the following areas as a minimum:

- construction specification to be used
- the need to implement sediment and erosion controls prior to disturbing the site.

(g) Earthworks

1 Where earthworks cut and fill is proposed on properties or is part of the creation of new lots, a cut and fill plan shall be submitted with the design plans. The Earthworks cut and fill plan shall show the location and depth of all proposed cut and fill.

(h) Easements and Agreements

1 Where an inter-allotment drainage easement or a Council drainage easement must be created over a property outside the development site, a Deed of Agreement from all affected property owners will need to be submitted to Council prior to release of the Engineering Design Plans. Evidence is to be submitted to Council that the easement(s) has been registered with the Land Titles Office prior to issuing of the construction certificate or subdivision certificate.

2 Where it is proposed to discharge collected runoff to an existing inter-allotment drainage easement, the applicant shall submit to Council information to demonstrate that the subject property enjoys legal rights to use the inter-allotment drainage easement. This information must be received before Council releases the Engineering Design Plans.

3 Where an agreement is reached with an adjacent landowner to increase flood levels on his/her property or otherwise adversely affect his/her property, a letter signed by all the landowners outlining what they have agreed to and witnessed by an independent person shall be submitted prior to any approval of the engineering plans.

4 Where it is proposed to divert, direct or intensify the flow of stormwater into adjoining property, a "permit to discharge stormwater" shall be sought and submitted to Council prior to the approval of Engineering design plans. The above shall apply unless otherwise specified by Council.

5 Where work is proposed within an adjoining property, written consent is required from the adjoining property owner(s) outlining they will permit the applicant's contractors to enter their property and undertake all work necessary. This letter of consent must be submitted to the Principal Certifying Authority prior to issuing of the construction certificate for the building works.

(h) Flood Studies

1 A flood study will generally be required to support any application on properties affected by flooding from watercourses and on properties affected by overland flow from a significant upstream catchment.

2 The flood study shall include:

- a survey to Australian Height Datum, of the floodway through the property, and adjoining properties where necessary, showing all physical features that may affect the path and depth of floodwaters. This shall extend sufficiently upstream and downstream to ensure all relevant hydraulic controls are contained within the survey

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

- plans of the catchment at a scale approved by Council, indicating catchment boundaries, contours and contour values
- a hydrological analysis of the upstream catchment and where necessary a hydraulic analysis of a relevant section of the piped drainage system, to determine overland flowrates through the property. Where known, flowrates will be supplied by Council
- plans and calculations of the pre-developed and post-developed position, depth and velocity of the floodway through the site and on adjoining properties where relevant.

3 Where computer modelling is used for either hydrological or hydraulic analysis, copies of final computer data files shall be provided to Council for approval.

4 Where applicable, plans should indicate the 1% and 10% AEP Flood Planning Level and the Probable Maximum Flood (PMF).

(i) Sediment & Erosion Control

1. After development consent is given an erosion and sediment control/water management plan shall be submitted to Council as part of the detailed engineering design. This plan must give all details for erosion, sediment and pollution controls. Note: **This design shall be site specific** and not a generalisation of erosion control philosophy. It shall also form part of the contract specifications for a contractor to comply with during construction.

2. Detailed designs shall include scaled drawings (no larger than 1:1000) and detailed specifications/diagrams which can be readily understood and applied on site by supervisory staff.

Items to be included, but not limited to, shall be:

- existing and final contours
- the location of all earthworks including roads, areas of cut and fill and re-grading
- location of access haulage tracks and borrow pits
- location and design criteria of erosion and sediment control structures
- location and description of existing vegetation
- proposed vegetated buffer strips and "no access" areas
- location of critical areas (vegetated buffer strips, drainage lines and structures, water bodies, unstable slopes, flood plains and seasonally wet areas)
- type and location of diversion works to direct uncontaminated run-on around areas to be disturbed
- revegetation program
- procedures for maintenance of erosion and sediment control
- procedures for dust control
- details for staging of works

3. No site works shall commence prior to approval of the detailed engineering design. All works are to be carried out in accordance with the approved management plan. Its implementation must be supervised by personnel with appropriate qualifications and/or experience in soil conservation on construction sites.

Approval

4. Notwithstanding the foregoing, Council may require erosion or sediment control works to be carried out additional to or instead of those works specified in the approved plan, should circumstances change during construction.

Additional Works

5. If required, examples of proposed subdivisions detailing locations of water quality structures, sediment and erosion control devices may be obtained from EPA Guidelines and Manual and used as a guide when preparing a detailed design.

Example Design

(j) Traffic Management

1 Whenever work is proposed to be undertaken within or adjacent to the public road reserve, it is vital that the impacts of construction on the regular traffic flows are considered. A Traffic Management Plan (TMP) shall be submitted with the design documents, for approval by Council, showing how traffic will be managed during all stages of construction.

**Traffic
Management
Plan
Submission**

A Traffic Management Plan shall include the type and location of the proposed construction works, the regular traffic flows and volumes, the expected traffic impacts during construction and how it is proposed to manage all traffic during and after construction. Construction Vehicle Movements shall be identified and included in the Traffic Management Plan. The vehicle movements shall include regular site access, construction vehicle parking and delivery and haulage vehicle access.

Traffic management shall include all traffic types including pedestrians and cyclists and consider the impacts on local residents and public transport. The Traffic Management Plan shall be prepared with consideration of minimising disruption to local residential traffic and adjoining land owners. Public consultation may need to be undertaken when developing the Traffic Management Plan.

Generally a Traffic Management Plan shall take the form of a site map or sketch showing all the details required. More complex construction or staged developments may be supported by written plan.

In certain circumstances, the Traffic Management Plan may need to be referred to the Local Traffic Committee and/or the Roads and Traffic Authority for ratification. Temporary Road Closures must comply with the requirements of Council's Road Closures Policy.

2 Traffic Control Plans (TCPs) shall be prepared based on the information contained within the approved Traffic Management Plan. Generally a Traffic Control Plan will not be required until application is made to Council for a permit under Section 138 of the Roads Act. Traffic Control Plans shall be prepared in accordance with requirements of the Roads and Maritime Services *Traffic Control at Work Sites* manual and must be prepared and endorsed by a person with current Roads and Maritime Services accreditation.

**Traffic Control
Plans**

The implementation of a Traffic Control Plan (TCP) and control of traffic with stop/slow bat must be undertaken by persons with current Roads and Maritime Services accreditation.

(k) Services Location

1 Where works are proposed within the road reserve, subsurface utility services and service lids and covers, shall be identified and shown on the design plans in accordance with Australian Standard AS5488-2013 Classification of subsurface utility information. Information on Utility Services shall be based on service authority searches (DBYD) and visual inspection of the site.

2 Subsurface utility services shall be shown to minimum Quality Class D in the design plans. Where possible conflicts between existing utility services and proposed new infrastructure (including road pavements), it shall be investigated by the design engineer to ensure compliance with minimum vertical and horizontal clearance to services.

ANNEXURE DQS-A

**WOLLONDILLY SHIRE COUNCIL
DESIGN CERTIFICATION REPORT**

Project Title: _____

DA No: _____

Consultant's Drawing No: _____

Name of Consultant: _____

Name and Address of Developer: _____

I certify that the subject drawings represent a design for which the attached design check lists provide a valid record.

I certify that this design has been carried out in accordance with current standards of good industry practice and in accordance with Wollondilly Shire Council's Design Specifications and specific instructions received with the exception of departures cited in the attached design check lists for Council's advice.

I certify that this Design will not significantly impact on the environmental factors of the area as interpreted under Part V of the Environmental Planning and Assessment Act.

I certify that this Design is in strict compliance with the development consent conditions and where a variance to the consent is found, written confirmation has been received from Council approving of the variance prior to the lodgement of Design Plans (this includes designs for staged construction).

I certify that all structural elements of the Design have been designed by a competent qualified practicing Civil or Structural Engineer.

Contact Phone: _____

Design Engineer/Surveyor Date

Contact Postal Address: _____

Qualifications

WOLLONDILLY SHIRE COUNCIL CHECK LIST - ENGINEERING PLANS

Project Title: _____

DA No: _____

Consultant's Drawing No: _____

Name of Consultant: _____

Name and Address of Developer: _____

PRELIMINARY

	<input type="checkbox"/>	N/A
1. Layout conforms to DA consent plan	<input type="checkbox"/>	<input type="checkbox"/>
2. All DA items checked	<input type="checkbox"/>	<input type="checkbox"/>
3. Design Certification submitted	<input type="checkbox"/>	<input type="checkbox"/>
4. TfNSW comments satisfied?	<input type="checkbox"/>	<input type="checkbox"/>
5. RFS Comments checked?	<input type="checkbox"/>	<input type="checkbox"/>
6. DNR comments checked?	<input type="checkbox"/>	<input type="checkbox"/>
7. CC application lodged	<input type="checkbox"/>	<input type="checkbox"/>
8. Landscaping plan provided (if DA requires)	<input type="checkbox"/>	<input type="checkbox"/>
9. Sydney Water compliance certificate provided (if DA requires)	<input type="checkbox"/>	<input type="checkbox"/>
10. Vegetation Management Plan submitted (if DA requires)	<input type="checkbox"/>	<input type="checkbox"/>
11. Waste Management Plan provided (if DA requires)	<input type="checkbox"/>	<input type="checkbox"/>

GENERAL

	<input type="checkbox"/>	N/A
1. General Notes - S138 permit requirement noted	<input type="checkbox"/>	<input type="checkbox"/>
2. Construction notes provided	<input type="checkbox"/>	<input type="checkbox"/>
3. Inspection notes provided	<input type="checkbox"/>	<input type="checkbox"/>
4. Note to provide engineer's certification for internal works (industrial/commercial/medium density developments)	<input type="checkbox"/>	<input type="checkbox"/>
5. Location plan provided	<input type="checkbox"/>	<input type="checkbox"/>
6. Scales are satisfactory	<input type="checkbox"/>	<input type="checkbox"/>
7. Bench mark / datum shown	<input type="checkbox"/>	<input type="checkbox"/>
8. Chainage / bearing shown	<input type="checkbox"/>	<input type="checkbox"/>
9. Curve data / TPs provided	<input type="checkbox"/>	<input type="checkbox"/>
10. Pram ramps provided where required	<input type="checkbox"/>	<input type="checkbox"/>
11. Existing Services shown & conflict with Power pole, gas line, trees etc checked	<input type="checkbox"/>	<input type="checkbox"/>
12. Contour plan of lots (existing/proposed)	<input type="checkbox"/>	<input type="checkbox"/>
13. Extent of works shown	<input type="checkbox"/>	<input type="checkbox"/>

ROAD-VERTICAL/HORIZONTAL ALIGNMENT

	<input type="checkbox"/>	N/A
1. Long-section of Centre line design (min 1% grade required)	<input type="checkbox"/>	<input type="checkbox"/>
2. Carriageway width provided as per DCP	<input type="checkbox"/>	<input type="checkbox"/>
3. Verge/Footway width provided as per DCP	<input type="checkbox"/>	<input type="checkbox"/>
4. Vertical curves provided and length/sight distance satisfactory	<input type="checkbox"/>	<input type="checkbox"/>
5. Superelevation provided where required	<input type="checkbox"/>	<input type="checkbox"/>
6. Sight distance (Stopping/intermediate) sufficient	<input type="checkbox"/>	<input type="checkbox"/>
7. Low point location shown and drainage provided	<input type="checkbox"/>	<input type="checkbox"/>
8. Limit of construction treatment shown	<input type="checkbox"/>	<input type="checkbox"/>
9. Splay corners at intersection - 4x4m residential /10x10m industrial & collector roads	<input type="checkbox"/>	<input type="checkbox"/>
10. Existing roads shown	<input type="checkbox"/>	<input type="checkbox"/>
11. Turning circle at road end	<input type="checkbox"/>	<input type="checkbox"/>
12. Passing bays provided where required	<input type="checkbox"/>	<input type="checkbox"/>
13. Cycleway (2m wide reinforced concrete) provided as required	<input type="checkbox"/>	<input type="checkbox"/>
14. Concrete footpath (1.5 m wide) provided as required	<input type="checkbox"/>	<input type="checkbox"/>
15. No through road sign at the end of road	<input type="checkbox"/>	<input type="checkbox"/>

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

ROAD- CROSS SECTIONS

		N/A
1. Typical section provided	<input type="checkbox"/>	<input type="checkbox"/>
2. Pavement details shown	<input type="checkbox"/>	<input type="checkbox"/>
3. 10 mm single coat seal under 40 mm asphalt for new urban roads	<input type="checkbox"/>	<input type="checkbox"/>
4. AC 50 mm thick around cul-de-sac and turning heads	<input type="checkbox"/>	<input type="checkbox"/>
5. All cul-de-sac shall be kerb and guttered	<input type="checkbox"/>	<input type="checkbox"/>
6. AC seal is required when rural road grade is more than 16.67%	<input type="checkbox"/>	<input type="checkbox"/>
7. Kerb & gutter is required for grade >10%	<input type="checkbox"/>	<input type="checkbox"/>
8. Traffic loadings indicated	<input type="checkbox"/>	<input type="checkbox"/>
9. Crossfalls (footpath 4%, pavement 3%)	<input type="checkbox"/>	<input type="checkbox"/>
10. Batters min 1:4 fill/1:2 cut	<input type="checkbox"/>	<input type="checkbox"/>
11. Lot filling details shown	<input type="checkbox"/>	<input type="checkbox"/>
12. 1.2m turf behind footpath provided	<input type="checkbox"/>	<input type="checkbox"/>
13. Footpath width min 3.5 m around cul-de-sac bulb provided	<input type="checkbox"/>	<input type="checkbox"/>
14. Cross drawn to full extent to see impact on properties	<input type="checkbox"/>	<input type="checkbox"/>

ROAD INTERSECTION

		N/A
1. Intersection treatment (AUL/AUR/BAL etc) provided	<input type="checkbox"/>	<input type="checkbox"/>
2. Intersection turning circle plotted	<input type="checkbox"/>	<input type="checkbox"/>
3. Widening at intersection	<input type="checkbox"/>	<input type="checkbox"/>
4. Intersection sight distances(SISD/ESD)	<input type="checkbox"/>	<input type="checkbox"/>

KERB RETURNS

		N/A
1. KR profiles for all intersections provided	<input type="checkbox"/>	<input type="checkbox"/>
2. Arc lengths shown	<input type="checkbox"/>	<input type="checkbox"/>
3. Crossfalls/grades shown	<input type="checkbox"/>	<input type="checkbox"/>
4. Contours plotted	<input type="checkbox"/>	<input type="checkbox"/>
5. Lowpoints to be clear of TP by 1.5m	<input type="checkbox"/>	<input type="checkbox"/>

ROUNDBABOUTS

		N/A
1. Inscribed circle radius	<input type="checkbox"/>	<input type="checkbox"/>
2. Turning circles	<input type="checkbox"/>	<input type="checkbox"/>
3. Deflection	<input type="checkbox"/>	<input type="checkbox"/>
4. Island offsets	<input type="checkbox"/>	<input type="checkbox"/>
5. Pavement RLs	<input type="checkbox"/>	<input type="checkbox"/>
6. Crossfalls	<input type="checkbox"/>	<input type="checkbox"/>
7. Linemarking	<input type="checkbox"/>	<input type="checkbox"/>
8. Island landscaping	<input type="checkbox"/>	<input type="checkbox"/>
9. Island drainage	<input type="checkbox"/>	<input type="checkbox"/>
10. Island details (structural)	<input type="checkbox"/>	<input type="checkbox"/>

DRIVEWAYS

		N/A
1. Location satisfactory?	<input type="checkbox"/>	<input type="checkbox"/>
2. Long Section provided when steeper grades more than 3%	<input type="checkbox"/>	<input type="checkbox"/>
3. Vehicle crossing template used for steep grade	<input type="checkbox"/>	<input type="checkbox"/>
4. Carriageway width, crossfall satisfactory	<input type="checkbox"/>	<input type="checkbox"/>
5. Passing bays provided	<input type="checkbox"/>	<input type="checkbox"/>
6. Joint details if concrete	<input type="checkbox"/>	<input type="checkbox"/>
7. Vehicle Crossing details (heavy duty crossing required?)	<input type="checkbox"/>	<input type="checkbox"/>
8. Driveway drainage considered	<input type="checkbox"/>	<input type="checkbox"/>
9. Existing driveways affected by new works?	<input type="checkbox"/>	<input type="checkbox"/>

CAR PARKING

		N/A
1. Clear width/depth of space	<input type="checkbox"/>	<input type="checkbox"/>
2. Clear width of manoeuvring lane	<input type="checkbox"/>	<input type="checkbox"/>
3. Layout acceptable from traffic safety	<input type="checkbox"/>	<input type="checkbox"/>
4. Pavement Design/Sealing provided	<input type="checkbox"/>	<input type="checkbox"/>
5. Vehicle turning template plotted	<input type="checkbox"/>	<input type="checkbox"/>
6. Carparking area grade max 5%	<input type="checkbox"/>	<input type="checkbox"/>

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

SOIL EROSION

		N/A
1. Notes provided	<input type="checkbox"/>	<input type="checkbox"/>
2. Site fences shown	<input type="checkbox"/>	<input type="checkbox"/>
3. Stabilised entry/exit	<input type="checkbox"/>	<input type="checkbox"/>
4. Pits protection	<input type="checkbox"/>	<input type="checkbox"/>
5. Turfing /grass seeding/bitumen spray on disturbed areas	<input type="checkbox"/>	<input type="checkbox"/>
6. Stockpiles location/fence	<input type="checkbox"/>	<input type="checkbox"/>
7. Sedimentation basin required? Show calculation	<input type="checkbox"/>	<input type="checkbox"/>
8. No trees to be removed without Council consent	<input type="checkbox"/>	<input type="checkbox"/>
9. Dust control measures shown on plan	<input type="checkbox"/>	<input type="checkbox"/>
10. ESCP undertaken for each stage	<input type="checkbox"/>	<input type="checkbox"/>

STORMWATER DRAINAGE

		N/A
1. Designed for recurrence interval 1:10 urban, 1:5 rural, 1:20 industrial	<input type="checkbox"/>	<input type="checkbox"/>
2. Designed checked for 1:100 year ARI	<input type="checkbox"/>	<input type="checkbox"/>
3. Catchment /subcatchment plan provided	<input type="checkbox"/>	<input type="checkbox"/>
4. Calculation schedule - hydrologic/hydraulic provided	<input type="checkbox"/>	<input type="checkbox"/>
5. Pipeline long sections provided	<input type="checkbox"/>	<input type="checkbox"/>
6. Surface/invert levels for pipes/pits	<input type="checkbox"/>	<input type="checkbox"/>
7. Pipe grade/size/class shown	<input type="checkbox"/>	<input type="checkbox"/>
8. Pit schedule-type/geometry/location/lintel length/inlet capacity	<input type="checkbox"/>	<input type="checkbox"/>
9. Curves pipelines provided on curves	<input type="checkbox"/>	<input type="checkbox"/>
10. Line No/Pipe size on Eng Sheets shown	<input type="checkbox"/>	<input type="checkbox"/>
11. Cover to pipes min 600 mm under roads	<input type="checkbox"/>	<input type="checkbox"/>
12. Pits to have step iron if depth > 1m	<input type="checkbox"/>	<input type="checkbox"/>
13. 1m high handrails in pits & headwalls in public reserve	<input type="checkbox"/>	<input type="checkbox"/>
14. Upstream run off considered in calculation	<input type="checkbox"/>	<input type="checkbox"/>
15. Connection to existing pit / K&G / creek - shown on plan	<input type="checkbox"/>	<input type="checkbox"/>
16. Post-development flow vs predevelop for creek / existing system	<input type="checkbox"/>	<input type="checkbox"/>
17. Gutter Flow Width max 2m	<input type="checkbox"/>	<input type="checkbox"/>
18. Ponding depth at sag pits	<input type="checkbox"/>	<input type="checkbox"/>
19. Overland flow path shown for 1:100 ARI rainfall	<input type="checkbox"/>	<input type="checkbox"/>
20. V*D < 0.4 m/s for overland flow path	<input type="checkbox"/>	<input type="checkbox"/>
21. Drainage easement width shown as per pipe size	<input type="checkbox"/>	<input type="checkbox"/>
22. Downstream swale drain shape and levels shown	<input type="checkbox"/>	<input type="checkbox"/>
23. Reverse cross fall on footpath in flow path	<input type="checkbox"/>	<input type="checkbox"/>
24. All channels, open drains shall be turfed	<input type="checkbox"/>	<input type="checkbox"/>
25. WSUD elements are detailed with supporting documents	<input type="checkbox"/>	<input type="checkbox"/>
26. Structural details of non-standard pits certified	<input type="checkbox"/>	<input type="checkbox"/>
27. Check for concentration of water onto adjoining property	<input type="checkbox"/>	<input type="checkbox"/>
28. Catch drains required to protect lots and roads	<input type="checkbox"/>	<input type="checkbox"/>

FLOOD MANAGEMENT

		N/A
1. Catchment area plan shown	<input type="checkbox"/>	<input type="checkbox"/>
2. Height of 1% AEP flood and FFL calculated	<input type="checkbox"/>	<input type="checkbox"/>
3. Flood extent plotted in plan	<input type="checkbox"/>	<input type="checkbox"/>
4. Hydraulic/hydrologic calculation shown	<input type="checkbox"/>	<input type="checkbox"/>
5. Calibration carried out	<input type="checkbox"/>	<input type="checkbox"/>
6. Sensitivity analysis done	<input type="checkbox"/>	<input type="checkbox"/>
7. Software model parameters checked	<input type="checkbox"/>	<input type="checkbox"/>
8. Rainfall data correct	<input type="checkbox"/>	<input type="checkbox"/>
9. DxV product on floodways	<input type="checkbox"/>	<input type="checkbox"/>
10. Emergency evacuation route provided for >1% AEP event	<input type="checkbox"/>	<input type="checkbox"/>
11. Flood warning signs at floodways, basins	<input type="checkbox"/>	<input type="checkbox"/>
12. No building/filling on floodways	<input type="checkbox"/>	<input type="checkbox"/>

TRAFFIC CONTROL DEVICES

		N/A
1. Line marking (carriageway/cycleway), RPM shown	<input type="checkbox"/>	<input type="checkbox"/>
2. Sign (Intersection/Giveway/Speed limit)	<input type="checkbox"/>	<input type="checkbox"/>
3. Chevron sign at T intersection provided	<input type="checkbox"/>	<input type="checkbox"/>
4. Guide Posts shown	<input type="checkbox"/>	<input type="checkbox"/>
5. Guard Rails provided	<input type="checkbox"/>	<input type="checkbox"/>
6. Safety Barriers provided	<input type="checkbox"/>	<input type="checkbox"/>
7. Stop sign is required at 4 way intersection	<input type="checkbox"/>	<input type="checkbox"/>

SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN

- 8. Plans need to be referred to Traffic Committee for approval of line marking, signposting etc.

TRAFFIC CONTROL PLAN

N/A

- 1. Dimensions provided on the plan
- 2. Signs sufficient
- 3. Follows TfNSW guideline
- 4. Traffic Controller required
- 5. Night time treatment provided
- 6. Work zone defined
- 7. Risk assessment done
- 8. Pedestrian and business access provided at all times
- 9. DTR required if speed limit of 40k is shown on plan
- 10. TCP prepared by/TfNSW ticket no

WORK-AS-EXECUTED PLAN

N/A

- 1. Stripped and finished levels shown
- 2. Subsoil drains shown
- 3. Engineer's certification for construction provided for internal works, bridge etc
- 4. Name of new road proposed
- 5. WAE levels match with design levels
- 6. Basin capacity

MISCELLANEOUS

N/A

- 1. Structural certification for bridge, structures, retaining walls etc provided
- 2. Existing structures shown
- 3. Street name signs provided
- 4. Guide posts provided
- 5. Existing SSMS
- 6. Road Safety Audit Report Stage 3 done
- 7. List of works that are to become Council's Asset
- 8. Possible adverse impacts on neighbouring properties examined
- 9. Consent from adjoining owners to allow construction of batter, tail out drain, install culvert and access for any other purpose required for the development works

COMMENTS

REFERENCE

DESIGN
SPECIFICATION

D1

**GEOMETRIC ROAD DESIGN
(Urban and Rural)**

Amendment Record for this Specification Part

This Specification is Council’s edition of the AUS-SPEC generic specification part and includes Council’s primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New text is shown underlined and deleted text shown struck through (eg or as 'DELETED'). New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is ‘A’ for additional script ‘M’ for modification to script and ‘O’ for omission of script. An additional code ‘P’ is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Added WSUD Guidelines to references	D1.03	A	DC	1/07/22
2	Updated urban road categories to align with Western Sydney Street Design Guidelines. Added provision for alternate designs.	D1.07	M	DC	1/07/22
3	Maximum longitudinal grades based on new street categories	Table D1.2	M	DC	1/07/22
4	Removed speed/radius tables	D1.11	O	DC	1/07/22
5	Modification of super-elevation when changing road category	D1.13	A	DC	1/07/22
6	Verge Widths	D1.14	A	DC	1/07/22
7	Fire vehicle access with traffic calming devices	D1.19	A	DC	1/07/22
8	Removed sight distance tables – refer to AUSTRROADS	D1.23	M	DC	1/07/22
9	Restructured table to make clearer	Table D1.6	M	DC	1/07/22
10	Flat bottomed table drain	D1.29	A	DC	1/07/22
11	Batters in flood prone areas	D1.30	A	DC	1/07/22
12	Extension of long and cross sections	D1.33	A	DC	1/07/22
13	Street sign positioning	D1.34	A	DC	1/07/22
14	Street tree requirements	D1.39	A	DC	1/07/22

SPECIFICATION D1 : GEOMETRIC ROAD DESIGN (Urban and Rural)

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SPECIFICATION D1 : GEOMETRIC ROAD DESIGN (Urban and Rural)**GENERAL****D1.01 SCOPE**

1. This section sets out the specifications developed specifically for the design of roadworks using principles of street design to ensure safety and improved amenity and to reduce pedestrian/vehicular conflicts.
2. A fundamental requirement of the design process is for designers to determine the vehicle speed which is deemed acceptable for a particular subdivision or section of road. The concept of designing to regulatory street speeds is contrary to the current principles of urban road design.
3. All relevant design principles must be integrated in the development of the road network. A careful balance is required between maximising amenity, safety and convenience considerations and those related to drivers' perception of driving practice.
4. To provide a level of consistency across the road network, Wollondilly Shire Council has adopted the Transport for New South Wales (TfNSW) technical references for road design. The primary technical references for TfNSW are the AUSTRROADS guides supported by supplements and technical directions issued by TfNSW.

D1.02 AIMS

1. The provision of a road system within a subdivision is to be designed so as to achieve the following aims:
 - Provide convenient and safe access to all allotments for pedestrians, vehicles and cyclists.
 - Provide safe, logical and hierarchical transport linkages with existing street system.
 - Provide appropriate access for buses, emergency and service vehicles.
 - Provide for a quality product that minimises maintenance costs.
 - Provide a convenient way for public utilities.
 - Provide an opportunity for street landscaping.
 - Provide convenient parking for visitors.
 - Have appropriate regard for the climate, geology and topography of the area.

D1.03 REFERENCE AND SOURCE DOCUMENTS**(a) Council Specifications**

Western Sydney Street Design Guidelines September 2020

Wollondilly Shire Council Water Sensitive Urban Design Guidelines November 2020

All Specifications for Design and Construction.

(b) Australian Standards

AS 2890.1 Parking facilities: Off-street car parking. (See D13 for additional details)

(c) State Authorities

Transport for NSW - Road Design Guide.

Transport for NSW – Walking Space Guide (July 2020)

Department of Housing – Road Manual, 1987.

Department of Urban Affairs (formerly Environment) and Planning - Technical Bulletin 12 (1981), Residential Road Widths.

Resource NSW – Better Practice Guide for Waste Management in Multi-Unit Dwellings (2002)

(d) Primary Technical References

AUSTROADS

Guide to Road Design
Guide to Traffic Management

The Institute of Municipal Engineering Australia, Qld Division - 1993: Design Guidelines for Subdivisional Streetworks.

ARRB Special Report No. 33, L E Comerford: A Review of Subdivision Road Design Criteria.

Joint Venture for More Affordable Housing – 1989: Australian Model Code for Residential Development. (AMCORD)

Stapleton, C 1984: Streets Where We Live - A Manual for the Design of Safer Residential Estates.

Stapleton, C 1988, Dept of Transport South Australia: Planning & Road Design for New Residential Subdivisions.

Brindle, R 1988, ARRB: Planning & Design of the Local Distributor.

Colman, J 1978, ARRB: Streets for Living.

Pak-Poy Kneebone - 1989: Research Study into Road Characteristics for Residential Development.

Department of Infrastructure, Planning and Natural Resources 2003 Guide: *Roads and Salinity* (ISBN: 0 73475377 2)

D1.04 CONSULTATION

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

D1.05 PLANNING CONCEPTS

1. In new areas (as distinct from established areas with a pre-existing road pattern) each class of route should reflect its role in the road hierarchy by its visual appearance and related physical design standards. Routes should differ in alignment and design standard according to the volume of traffic they are intended to carry, the desirable traffic speed, and other factors.

Road Hierarchy

2. The road pattern and width must be in conformity with that shown on any relevant area Development Control Plan. In areas not covered by these plans, the pattern and width(s) will be determined by Council on their merits and the urban and rural design criteria outlined herein.

3. The road network for residential developments should have clear legibility.

4. The road network should reinforce legibility by providing sufficient differentiation between the road functions.

5. Wherever possible distinct landmark features such as watercourses, mature vegetation or ridge lines should be emphasised within the structural layout so as to enhance the legibility.

Legibility

6. Whilst legibility can be enhanced by introduced physical features such as pavement and lighting details, the road network should by its inherent design and functional distinction provide the necessary legibility.

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

8. Low speeds are desirable in lightly trafficked streets to protect pedestrians and allow them to share the street with vehicles.

9. Bus routes should be within acceptable walking distance of all dwellings. Where possible, residential properties shall be within 400 metres of a bus stop.

10. Each road category must satisfy reservation and width requirements and meet all construction and design requirements.

11. Information provided by the NSW Government that indicates salinity may occur in parts of the Wollondilly Local Government Area (LGA). This salinity potential is due to inherent characteristics of the Wollondilly LGA landscape. As a result, buildings and other infrastructure in the Wollondilly LGA may be susceptible to salt damage.

Salinity

The applicant must thoroughly investigate the site to determine if there are any salinity issues to be addressed. The designer shall address salinity in their design. Steps taken may include, but are not limited to:

- Minimising depth of excavation/disturbance required for roadworks;
- Minimising infiltration of surface waters by providing adequate sub-soil drainage;
- Provision of adequate drainage for upstream catchments; and
- Use of appropriate materials in construction of roadworks.

Designers should also follow guidelines set out in Department of Infrastructure, Planning and natural Resources (2003) Guide: *Roads and Salinity* (ISBN: 0 73475377 2).

12. The principles of street function and the objectives of the design of streets shall be adopted from the Western Sydney Planning Partnership Street Design Guides.

13. Road safety and regulation shall be adopted in accordance with the TfNSW Technical References. Road safety and regulation requirements must take preference over the Street Design Guidelines.

D1.06 PLAN REQUIREMENTS – See DQS

D1.07 ROAD HIERARCHY

1. A hierarchical road network is essential to maximise road safety, residential amenity and legibility. Each class of road in the network serves a distinct set of functions and is designed accordingly. The design should convey to motorists the predominant function of the road.

2. Council’s Asset Management System has adopted a road hierarchy that classifies each road in order to determine the funding and Level of Service that will be provided for that road. For design purposes, a category system has been developed that provides specific details of road characteristics.

Road hierarchy and Category to be adopted:

- State Road (Classified) – TfNSW to determine road characteristics
- Regional Road (Classified) – TfNSW to determine road characteristics
- Regional Road (Unclassified)
- Major Collector
- Minor Collector
- Urban Residential
- Rural Residential
- Public Transport Route

Table D1.1 outlines the typical road sections to be used for new roads created with developments. These street types have been taken from the Western Sydney Street Design Guidelines 2020. Reference should be made to these guidelines when designing new roads.

Existing road improvements and upgrades will be determined by the relevant Road Authority. Alternate road section designs can be considered where road side swales are proposed to meet the WSUD Guidelines requirements. Verge widths should be considered as outlined in Table D1.4.

3. Road sections adopted from the Western Sydney Street Design Guidelines must be amended to achieve the minimum widths outlined in Table 1A. Alternate road sections may be accepted by Council where it can be demonstrated that the minimum design criteria as outlined in this specification can be achieved. Alternate road sections should achieve the minimum widths as outlined below:

Variations to Street Design Guides

Table 1A

Asset	Minimum Width
Parking bays (minor urban/rural residential)	2.3 m

Parking bays (major collectors/public transport routes)	2.5 m
Carriageway width (divided road)	3.0 m 5.5 m (without designated parking bays)
Two lane carriageway width (between kerb extensions)	6.0 m (excludes bus routes) 7.0 m (bus routes)
Bus lane	3.5 m
Verge	As per Table D1.4

Table D1.1

Road Hierarchy	LS1#	LS2#	LS3 [^] A+B	LS4 A+B	RL	LC A+B	HS	IS	RtL	SA
State Road	TfNSW									
Regional Classified	TfNSW									
Regional Un-classified	-	-	-	-	-	-	-	✓	-	-
Major Collector	-	-	-	✓	-	-	-	-	-	✓
Minor Collector	-	-	-	✓	-	✓	✓	-	-	✓
Urban Residential	✓	✓	✓	✓	✓	✓	✓	-	✓	✓

Rural Residential	AS PER CAT G1, G2, G3, H									
Public Transport Bus Route	-	-	-	-	-	✓	-	-	-	✓
Industrial	-	-	-	-	-	✓	-	✓	-	✓
<p>* Before selecting a road category, the Design Guidance as outlined in the Street Design Guidelines must be carefully considered,</p> <p># Local Streets 1 & 2 are only available in very limited situations. Council will only accept these categories where there is strict accordance with design guidance outcomes.</p> <p>^ Case B LS3 is the preferred design. Case A Local Street 3 is only to be used where it can be demonstrated to Council that on street parking demand is low.</p>										

3. Category G and H, have a residential and agricultural function and generally carry a lower volume of traffic but at possibly higher speeds than urban areas. These roads generally provide residential and agricultural land access and can also provide a connection between rural and urban areas. Roads should provide an all-weather access to residential lots. **Cat G & H**
4. Local Street Type 1 provides a very slow speed shared travel zone which is designed to prioritise people walking and who use a wheelchair and environmental amenity while discouraging vehicular thoroughfare. The use of traffic calming measures and an absence of footpaths encourages informal sharing of street space between all street users. **LS1 - Local Street 1**
5. Local Street Type 2 is a yield street and is designed to be a very slow speed environment. Yield streets require that one vehicle yield to another as they pass at specific points, for example through a pinch point created by kerb extensions. Different mechanisms are used to limit behavioural speeds on these types of roads, such as a narrow carriageway, parking or kerb extensions. Narrow carriageways also allow for maximised verge space for street tree planting and WSUD features. These streets discourage vehicular traffic and balance car parking with other environmental and community uses of the verge. **LS2 - Local Street 2**
6. Local Street Type 3 are slow-speed streets within low density residential areas. They are designed to be quiet and able to accommodate low levels of through traffic. They provide dedicated carriageways with on-street parking bays interspersed with street trees, WSUD elements, and typical barrier kerbs to delineate the verge. **LS3 - Local Street 3**
7. Local Street Type 4 are slow-speed streets within medium density neighbourhoods which are designed to be quiet and accommodate low levels of through traffic. They serve higher levels of people movements due to their multi-residential nature from which traffic calming measures and adequate infrastructure is vital. Street Trees line either side of the narrowed carriageway and verges give space to various environmental and community uses. **LS4 - Local Street 4**
8. Residential Laneways provide access to the rear of dwellings. They are designed to be very slow, shared environments that allows for incidental community uses and placemaking by adjoining residents. These streets are designed to accommodate safe access for people walking and who use a wheelchair. Elements such as planting, seating and lighting where applicable, ensure a safe shared zone where vehicle calming measures provide access to local access and service vehicles only. **RL - Residential Laneway**
9. Local Collector streets typically form the primary thoroughfare route into and through residential neighbourhoods. They provide important connections within and between neighbourhoods to key local destinations. The character of Local Collectors is important to neighbourhood legibility and sense of place. Environment and local life predominate, and improved amenity is encouraged over the use of vehicles. High quality walking, cycling and public transport facilities are all prioritised within these streets. **LC - Local Collector**
10. High Streets are unique to commercial centres. High quality public amenity and generous verge space is crucial to the various environmental and community uses unique to High Streets. High Streets are designed to foster street life and activity. Amenity for people walking or who use a wheelchair is prioritised and assembling in the street is encouraged. Footpaths are designed to accommodate high numbers of people alongside other footpath uses such as seating and retail spill out. **HS - High Street**
11. Industrial Streets serve commercial and industrial precincts. They cater to buses and heavier vehicles with particular design requirements, alongside general traffic using these spaces. An increased width allows opportunities for environmental and community uses, such as understorey planting the verge space and street trees in the carriageway to combat urban heating. **IS - Industrial Street**

12. Retail Laneways are designed as very slow, shared environments. They balance the active, social functions of a laneway with the service-related functions of delivery and basement access to retail tenancies. Retail Laneways are first and foremost high quality public spaces which offer vibrancy within local street networks. Retail laneways are designed to accommodate safe movement and congregation of people with elements such as planting, seating, and lighting where applicable. This ensures a safe shared zone where vehicle calming measures provide for local access and service vehicles only.

***RtL - Retail
Laneway***

13. Sub-Arterial Roads are designed as higher-order neighbourhood streets which typically facilitate the connection of the arterial road network to local street networks. Sub-Arterial Roads support vehicular and public transport activity alongside providing safe movements for people walking and cycling.

***SA - Sub-Arterial
Roads***

D1.08 ROAD NETWORK

1. The design features of each type of road convey to the motorist its primary functions and encourage appropriate driver behaviour.

2. Traffic volumes and speeds on any road should be compatible with the residential functions of that road.

3. The maximum length of an access street should ensure its status as a residential place is retained, where the traffic, in terms of speed and volume will enable the integration of pedestrian, cycle and vehicular movements. This length will also ensure that residential convenience is not unduly impaired as a result of speed restraints.

4. The length of major and minor collectors within a development should be minimised.

5. The distance required for motorists to travel on all streets within the development should be minimised.

6. Where access streets form part of a pedestrian or cycle network, access links should provide suitable connectivity with adjoining access streets or open space systems so as to ensure such pedestrian and cycle network are functionally efficient.

7. The road network should ensure that no road links with another road which is more than two levels higher or lower in the hierarchy. In exceptional circumstances roads may link with others that are more than two levels apart, however, no access street or local street should have access to an access-controlled arterial road.

Road Links

8. Connections between internal roads should be T-junctions or controlled by roundabouts.

9. The road layout should conform to the requirements of the external road network and satisfy the transport provisions of an outline development plan.

10. The external road network should be designed and located to provide routes which are more convenient for potential through local road network. Major roads should be provided at intervals of no more than 1.5 km and should be complete and of adequate capacity to accommodate projected movements. The internal road system should not provide through routes that are more convenient than the external road network.

***External Road
Network***

URBAN STREET DESIGN CRITERIA

The following Urban Design Criteria shall be generally adopted for roads with an Urban Residential hierarchy or local streets of 50 km/h or less. Design objectives and function must be in accordance with the Western Sydney Planning Partnership Street Design Guidelines.

D1.09 DESIGN SPEED

1. Design speed is generally used as the basic parameter in the specification of design standards, determining the minimum design value for other elements. Transport for NSW bases its current design standards on a travel speed rather than a design speed. Travel speed identifies a speed/horizontal radius relationship. This approach is intended for roads of a minimum travel speed of 60 km/h. The maximum speed limit in NSW for built-up areas is 60 km/h and this should be used in calculating design values which depend on speed, (eg collector and distributor roads) however, in difficult topography or urban local streets, the design speed may be reduced. Vehicular speeds are also limited by road intersections as well as changes in horizontal and vertical alignment.

**TfNSW
Guidelines**

2. Adoption of a low design speed discourages speeding, however, where vertical or horizontal curves of low design speed are located in otherwise high speed sections (tangents) the result is a potentially dangerous section of road. It should be recognised that in low standard roads, operating speeds will tend to be in excess of arbitrary speed standards. Attention should be given to ensuring that potentially hazardous features are visible to the driver and adopting traffic engineering measures which will help a driver avoid errors of judgement.

Low Speeds

3. Generally, design speeds should be adopted using the TfNSW Primary Technical References (AUSTROADS) and should always reflect the likely travel speed.

D1.10 LONGITUDINAL GRADIENT

1. A general minimum gradient of 1.0 per cent should be adopted. In very flat conditions it may be reduced to 0.5 per cent over short distances, as agreed by council.. It must be demonstrated that 0.5% will not impact on road function and drainage. Maximum grades are shown in Table D1.2.

Flat Terrain

Table D1.2

Street Category	Maximum Grade
Local Street (less than 150m)	20%
Local Street (greater than 150m)	16%
Local Collector	10%
Industrial Street	6%
Residential Cul-de-sac	5%
Industrial Cul-de-sac	6%

2. Longitudinal grade through intersections should not exceed 4 per cent, the actual gradient being dependent on the type of terrain. Design of the road alignment and the grades used are interrelated. A steep grade on a side street is undesirable if vehicles have to stand waiting for traffic in the priority road.

D1.11 HORIZONTAL CURVES AND TANGENT LENGTHS

1. The horizontal alignment of a road is normally in a series of tangents (straights) and curves. The choice of the horizontal alignment is normally determined from the design speeds for a particular street within the road hierarchy as described in Clause D1.09. Designers should ensure that, for a given design speed, the minimum radius of curvature utilised is such that drivers can safely negotiate the curve. Curves which progressively tighten produce an uncomfortable sense of disorientation and alarm. Sudden reverse curves, which drivers cannot anticipate, also have a potential to cause similar conditions.
2. Where speed restriction is provided by curves in the street alignment the relationship between the radius of the curve and the desired vehicle speed is given in AUSTRROADS Guide to Road Design Part 3: Geometric Design section 7..
3. To determine appropriate lengths for tangents between speed restrictions, which may be curves, narrow sections or other obstructions, refer to AUSTRROADS Guide to Road Design Part 3: Geometric Design section 7.
4. Sight distance on curves shall be determined in accordance with the Transport for NSW technical references.

Speed/Radius Relation

D1.12 VERTICAL CURVES

1. Vertical curves will be simple parabolas and should be used when the change of grade exceeds those in Table D1.3. The desirable minimum design speed is 60 km/h. The length of the crest vertical curve for stopping sight distance should conform with Transport for NSW technical references. These standards are based on 1.5 seconds reaction time which provides a reasonable safety margin for urban conditions, where drivers' reaction time is usually considered to be lower than in rural conditions.
2. For adequate riding comfort, lengths of sag vertical curves should conform with Transport for NSW technical references. As residential roads are usually lit at night, the criterion for designing sag vertical curves is a vertical acceleration of 0.05 g for desirable riding comfort, and 0.10 g for minimum riding comfort. The minimum lengths for vertical curves are shown in Table D1.3.

Riding Comfort

Table D1.3

	Urban and Rural Residential (m)	Major and Minor Collector(m)	Regional Road (Unclassified)(m)
Minimum vertical curve	25	35	50
Absolute minimum vertical curve (to be applied at road junctions only)	12	12	20

3. Junctions of roads should be located at a safe distance from a crest, determined by visibility from the side road. Location of a side road at a crest should only occur if there is no suitable alternative.

Side Road

4. Drainage poses a practical limit to the length of sag curves and a maximum length (in metres) of 15 times the algebraic sum of the intersecting vertical grades (expressed as a percentage) has been suggested. This is to avoid water ponding in excessively flat sections of kerb and gutter.

Sag Curves

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

- The design speed of the road in both horizontal and vertical planes should be of the same order.
- Combined horizontal and vertical stopping sight distance and minimum sight distance should be considered three dimensionally.
- Sharp horizontal curves should not be introduced at or near the crest of a vertical curve. A horizontal curve should leave the vertical curve and be longer than the vertical curve.
- A short vertical curve on a long horizontal curve or a short tangent in the gradeline between sag curves may adversely affect the road's symmetry and appearance.

D1.13 SUPERELEVATION

1. Superelevation, where required, shall be designed in accordance with Transport for NSW technical references.

2. Careful consideration must be given to the effects of superelevation on road surface drainage. Additional piping may be required to ensure ponding and cross pavement flows do not occur on curves due to superelevation.

3. Superelevation is generally not required for low speed local streets.

4. Superelevation may need to be removed when road hierarchy is changed from rural to urban. This may require additional road reconstruction and should be discussed with council development engineers.

D1.14 CARRIAGEWAY WIDTH

1. The cross section of the road reserve must cater for all functions that the road is expected to fulfil, including the safe and efficient movement of all users, provision for parked vehicles, acting as a buffer from traffic nuisance for residents, the provision of public utilities, stormwater and streetscaping.

Functions

2. The carriageway width must allow vehicles to proceed safely at the operating speed intended for that level of road in the network and with only minor delays in the peak period. This must take into consideration the restrictions caused by parked vehicles where it is intended or likely that this will occur on the carriageway. Vehicles include trucks, emergency vehicles and, on some roads, buses. (Refer to Clause D1.21 for bus routes.)

Vehicles

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

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

Reversing

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

6. The verge when considered in conjunction with the horizontal alignment and permitted fence and property frontage treatments should provide appropriate sight distances, taking into account expected speeds and pedestrian and cyclist movements.

Verge

7. Verge width must be adequate to accommodate the infrastructure to be installed, including footpaths, signage, driveways, services, stormwater controls and street trees. Verge widths should ensure all infrastructure can occupy the space without impacting on the maintenance of the adjoining infrastructure. Regardless of adjacent street infrastructure, all verges must have a minimum width of 3.5 m. Table D1.4 outlines how much additional verge width should be added to the minimum 3.5 m for various elements. Road sections adopted from Table D1.1 will take preference over the allocations listed below.

Verge Width

Table D1.4

Verge Additions	Verge Width (m)
Add verge width for trees	+1.0
Add verge width for WSUD	+1.5
Add verge width for shared path	+1.0-1.5
Reduce verge width adjacent to public space, roadway	-2.0

8. Stopping sight distances and junction or intersection sight distances should be based on the intended speeds for each road type. Widening may be required at intersections to allow turning and stacked vehicles to pass. Refer to the AUSTRROADS Guides for details.

9. Permeable pavement is only permitted when it can be demonstrated to the satisfaction of Council, that it can achieve 25-year design life and subsoil infiltration will not impact adjacent pavements and kerb.

10. Traffic calming devices are only permitted when a traffic audit identifies possible compliance issues.

D1.15 CROSSFALLS

1. Desirably, roads should be crowned in the centre. Typical pavement crossfalls on straight roads are:

<i>Pavement Type</i>	<i>Crossfall</i>
Bituminous seal coat	3 per cent
Bituminous concrete pavement	3 per cent
Cement concrete pavement	3 per cent

2. There are many factors affecting levels that may force departures from these crossfalls. Differences in level between road alignments can be taken up by offsetting crown lines or adopting one way cross falls. Sustained crossfalls should not exceed 4 per cent, although up to 6 per cent may be used where unavoidable. The rate of change of crossfall should not exceed: 6 per cent per 30 m for through traffic; 8 per cent per 30 m for free flowing turning movements; or 12 per cent per 30 m for turning movements for which all vehicles are required to stop. Offset crowns should be used only in exceptional circumstances and should not be used simply to reduce earthworks or batter requirements.

Offset Crown Changes

3. The crossfall on a collector or sub-arterial road should take precedence over the grade in side streets. Standard practice is to maintain the crossfall on the priority road and adjust the side road levels to suit. The crossfall in side streets should be warped quickly either to a crown or a uniform crossfall depending on the configuration of the side street. A rate of change of grade of two per cent in the kerb line of the side street relative to the centre line grading is a reasonable level.

Priority Road

D1.16 FOOTWAY AREAS

1. A suitable design for the footway will depend on utility services, the width of pathways, access to adjoining properties, likely pedestrian usage and preservation of trees. Generally, a pathway shall not be placed over services and should be located to minimise any impact of the footpath from service trenching or repairs. Low level paths are undesirable but may be used in exceptional circumstances where normal crossfalls are impracticable. Generally a 4% crossfall should be provided from the property boundary to the top of kerb. Crossfalls in footway paving should not exceed 4 per cent. Longitudinal grade usually parallels that of the road.

Utility Services

2. Differences in level across the road between alignments may, with Council's approval, be accommodated by:

Options

- Cutting at the alignment on the high side
- Battering at the alignment on the low side and providing the footway at normal level and crossfall.
- A uniform crossfall across the carriageway.
- The lower footway being depressed below the gutter level.

3. The above measures can be used singularly or combined. The footway formation should extend with a 0.6m berm beyond the road alignment.

4. Where it is necessary to raise or lower the footway in front of a property, the adjoining sections of footway must be regraded to provide a smooth transition.

5. If access to adjoining properties is affected by the footway regarding, all necessary work shall be done to restore satisfactory pedestrian and vehicular access.

6. If the ground level of the property is above or below the finished level of the footway then adequate measures must be taken to support the land by constructing stable earth batters or retaining structures. These are to be fully contained within the property and not encroach onto the public footway.

7. Where footway levels necessitate the retaining of an adjoining property, written permission from the affected property owner must be obtained and submitted to Council before the Engineering Plans will be approved. If the approval cannot be secured, Council will give consideration to allowing the retaining structure within the road reserve provided adequate footway width is available.

8. Pedestrian access to all lots in a new subdivision or development must be considered. For new subdivisions footpath must be provided on both sides of the road. Pedestrian crossing points within the road network must be carefully considered to ensure appropriate sight lines are provided at all crossing points. This may require additional footpath or pedestrian crossing facility upgrades.

Footpath Both Sides of Road

D1.17 INTERSECTIONS

1. The design of intersections or junctions should allow all movements to occur safely without undue delay. Projected traffic volumes should be used in designing all intersections or junctions on sub-arterial roads.

Traffic Volumes

2. Intersection design for the junction of subdivision roads with existing main rural, main urban and state highways should generally be designed in accordance with the Transport for NSW technical references.

Main Roads

3. Intersections with main roads, tourist roads or state highways are to be designed and constructed in accordance with the requirements of the Transport for NSW and Council.

**Tourist Roads
State Highways**

4. Where major intersections are required to serve a development complete reconstruction of the existing road pavements will be necessary where the speed environment and irregularity of the existing road pavement may endanger the safety of traffic in the locality.

5. Intersections should be generally located in such a way that:

Criteria

- The streets intersect at right angles.
- The landform allows clear sight distance on each of the approach legs of the intersection.
- The minor street intersects the convex side of the major street.
- The vertical grade lines at the intersection do not impose undue driving difficulties.
- The vertical grade lines at the intersection will allow for any direct surface drainage.
- Two side streets intersecting a major street in a right-left staggered pattern should have a minimum centre-line spacing of 40m. Left-right stagger intersections require 60-150m separation for stacking purposes. Designers are referred to the Transport for NSW technical references for details.

6. Adequate stopping and sight distances are to be provided for horizontal and vertical curves at all intersections.

7. Where required, appropriate provision should be made for vehicles to park safely.

8. In cul-de-sac streets adequate provision should be made at the end of the road for vehicle types which frequently use the streets to turn around. The absolute minimum vehicle size shall be a single unit garbage truck of 9.6m with a turning circle of 20m. The likelihood of parked vehicles obstructing turns should be minimal. Refer drawing W.S.C.D1.3 of this specification for drawings of Wollondilly Shire Council's Cul-de-sac Layouts.

9. The drainage function of the carriageway and/or road reserve must be satisfied by the road reserve cross-section profile.

10. Verge width at intersections is the highest value of the following minima:

Verge Widths

- The minimum width necessary to accommodate services, 1.5-2.0m wide footpath/ cycleway, verge parking and the desired level of landscaping.

- The minimum width necessary to satisfy acceptable noise levels.

11. All vehicle turning movements are accommodated utilising AUSTROADS Design Vehicles using AutoTURN (or similar software) or Turning Path Templates, as follows:

Turning Movements

- For turning movements involving Regional (Unclassified) and Major and Minor Collectors roads, the "design prime mover & semi-trailer (19.0m)" with turning path radius 15.0m.
- For turning movements involving Urban Residential streets the "design single unit truck/ bus (12.5m)" with turning path radius 15.0m
- For turning movements on Cul-de-sacs in Urban and Rural Residential roads, provision must be made for single unit garbage trucks up to 9.6m with a turning circle of 20m.
- For turning movements within, into and out of industrial /commercial development sites the "design single unit truck/bus (12.5m) " with turning radius 15.0m. Turning movements within the development may be reduced to a turning radius of 12.5m with approval in special circumstances. Provision for forward ingress and egress for heavy vehicles must be provided.
- For turning movements within carparks, into and out of residential development sites including medium density developments the "design car (5.0m)" with turning radius 8.0 m

12. Turning radii at intersections or driveways shall accommodate the intended movements without allowing desired speeds to be exceeded. The desirable kerb radii is 7.5m with a minimum kerb radii of 6.0m. Kerb radii greater than 7.5 metre should be avoided where possible.

Turning Radii

13. Where a road changes direction by more than 70° (such as a 90° bend) the minimum radius of the inside kerb line shall be 15.0m. Additional linemarking to separate traffic and parking restrictions may be required to ensure sweep paths are available for waste recovery vehicles.

D1.18 ROUNDABOUTS

1. Roundabouts are to be approved by Transport for NSW via the Wollondilly Shire Council Local Traffic Committee.

2. Roundabouts should generally be designed in accordance with the requirements of the Transport for NSW technical references (AUSTROADS Guide to Road Design Part 4B: Roundabouts). Designs adopting alternative criteria will be considered on their merits. Roundabout design should generally comply with the following:

- Entry width to provide adequate capacity
- Adequate circulation width to accommodate sweep paths of design vehicles (eg. Buses, trucks, cars), compatible with the entry widths .
- Central islands of diameter sufficient only to give drivers guidance on the manoeuvres expected
- Deflection of the traffic to the left on entry to promote gyratory movement
- Adequate deflection of crossing movements to ensure low traffic speeds

- A simple, clear and conspicuous layout
- Visibility of both circulating traffic and potentially conflicting traffic from other approaches
- Design to ensure that the speed of all vehicles approaching the intersection will be less than 50 km/h.

Approach Speed

D1.19 TRAFFIC CALMING

1. Calming devices such as thresholds, slowpoints, speed humps, chicanes and splitter islands should be designed in accordance with the Transport for NSW technical references and source documents listed at D1.03. These devices are to be approved by the Wollondilly Shire Council Local Traffic Committee as appropriate. Devices designs should generally comply with the following:

(a) Streetscape

- reduce the linearity of the street by segmentation
- avoid continuous long straight lines (eg. kerb lines)
- enhance existing landscape character
- maximise continuity between existing and new landscape areas.

(b) Location of Devices/Changes

- devices other than at intersections should be located to be generally consistent with streetscape requirements
- existing street lighting, drainage pits, driveways, and services may decide the exact location of devices
- slowing devices are optionally located at spacings of 100-150m.

(c) Design Vehicles

- emergency vehicles must be able to reach all residences and properties
- Urban and Rural Residential roads with a 'feeding' function between minor Collector roads should be designed for a AUSTROADS Design Single Unit Truck/Bus (12.5 m)
- where bus routes are involved, buses should be able to pass without mounting kerbs and with minimised discomfort to passengers.
- in newly developing areas where street systems are being developed in line with LATM principles, building construction traffic must be catered for.
- where traffic calming devices are provided, they are to not impeded fire vehicle access.

Design Vehicles

(d) Control of Vehicle Speeds

- maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings have only minor effects on average speeds, and usually little or no effect on maximum speeds
- speed reduction can be achieved using devices which shift vehicle paths laterally (slow points, roundabouts, corners) or vertically (humps, platform intersections, platform pedestrian/school/bicycle crossings)
- speed reduction can be helped by creating a visual environment conducive to lower speeds. This can be achieved by 'segmenting' streets into relatively short lengths (less than 300m), using appropriate devices, streetscapes, or street alignment to create short sight lines

Vehicle Speeds

(e) Visibility Requirements (sight distance)

- adequate critical sight distances should be provided such that evasive action may be taken by either party in a potential conflict situation. Sight distances should relate to likely operating speeds
- sight distance to be considered include those of and for pedestrians and cyclists, as well as for drivers
- night time visibility of street features must be adequate. Speed control devices particularly should be located near existing street lighting if practicable, and all street features/furniture should be delineated for night time operation.

Visibility

(f) Critical Dimensions

Many devices will be designed for their normal use by motor cars, but with provision (such as mountable kerbs) for larger vehicles. Refer AUSTRROADS Guide to Traffic Management Part 8: Local Street Management for typical dimensions.

D1.20 PARKING

1. The parking requirements for normal levels of activity associated with any land use should be accommodated on-site in accordance with the relevant Development Control Plans. Vehicular access to the parking and loading areas provided on-site shall conform with the design requirements outlined in the WSC.D13 ACCESS AND OFFSTREET PARKING.
2. Parking spaces provided on the verge or carriageway should be of adequate dimensions, convenient and provide safe access.

On-site Parking

D1.21 BUS ROUTES, STOPS AND SHELTERS

1. Bus routes will normally be identified by Council. It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that *no more than 5% of residents should have to walk in excess of 400 metres to catch a bus.* Normally roads above Urban and Rural Residential in the hierarchy are designed as bus routes. Bus routes shall be designed with appropriate lane width and set-down facilities. Generally lane widths shall be a minimum 3.5m.

Buses

Table D1.5 Bus Route Criteria

Road	Carriageway Width (min.)	Stops (Spacing)	Bays
------	--------------------------	-----------------	------

Minor Collector	13m	400 metre	
Major Collector	13m	400 metre	Shelters*
Regional	13m	400 metre	Shelters* and Bays

* Shelters are subject to Council's requirements.

2 Bus Stops are to be designed in accordance with the requirements of the Disability Standards for Accessible Public Transport 2002 and Australian Standards AS 1428.1 and AS 1428.4. Designs must be accompanied by certification from a suitably qualified professional that the design complies with these standards.

RURAL DESIGN CRITERIA

The following Rural Design Criteria shall generally be adopted for roads with a Rural Residential hierarchy and all roads adjacent to 'RU', 'R5' and 'E5' land zones or as directed by Council.

D1.22 GENERAL

1. In addition to the foregoing sections this section specifically applies to all those sites identified as being suited to rural subdivisions inclusive of rural home sites and hobby farm type of developments.

2. Design speed is to be generally used as the basic parameter of design standards and the determination of the minimum design value for other elements in rural subdivisions is to be based on the concept of a "speed environment" as outlined in Transport for NSW technical references.

Design Speed

3. Superelevation, widening and centreline shift and their associated transitions are to comply with the Transport for NSW technical references.

4. Where the table drain is likely to scour (velocity of flow > 2.0m/s or gradient >10%) a concrete dish drain, or similar structure is to be constructed along the invert, or alternatively the use of kerb and gutter with suitable lead-in/ lead-out drains or pits is encouraged. Also for grades of less than 0.5%, the inverts of the drain are to be concrete lined to prevent siltation.

Table Drain

5. All rural subdivisions should be designed to deny direct property access to major roads.

6. All rural residential subdivisions will be required to provide kerb and gutter on both sides of roads and piped drainage will generally be required.

Kerb and Gutter

7. Kerb and gutter should be considered in cul-de sac 'heads' in rural areas to provide suitable treatment for stormwater discharges.

8. Cul-de-sac heads are to have an asphaltic concrete wearing course and not a spray seal in order to protect the pavement from turning vehicles. The thickness of asphaltic concrete shall be minimum 50 mm and shall be laid on a single coat bitumen seal of 10 mm aggregates.

9. Roads with longitudinal gradient more than 10% shall have kerb and gutter on both sides.

D1.23 SIGHT DISTANCES

- | | |
|---|---|
| <p>1. Stopping sight distance shall be provided at all points on the road. The stopping sight distance is measured from an eye height of 1.15m to an object height of 0.2m, using a reaction time of 1.5 seconds. An intermediate sight distance measured from a height of 1.15m to a height of 1.15m is preferable at all times for speeds of 60 km/h and over.</p> | <p>Stopping Distance</p> <p>Intermediate Sight Distance</p> |
| <p>2. Stopping sight distance is the sum of distance travelled during the reaction time and the distance travelled during braking from the design speed to a stop.</p> | <p>Stopping Sight Distance</p> |
| <p>3. To calculate the Sight Stopping Distance, values for reaction time need to be assumed. Generally, this will be a value of 2.0 seconds, but may be reduced to 1.5 seconds or increased to 2.5 seconds in certain situations. Refer to Table 5.2 of AUSTRROADS Guide to Road Design Part 3 Geometric Design for the different road conditions and typical use for each reaction time.</p> | <p>Reaction Time</p> |
| <p>4. Coefficient of deceleration will vary depending on the road conditions and design vehicle. For most situations, a d value of 0.36 is recommended. Refer to Table 5.3 of AUSTRROADS Guide to Road Design Part 3 Geometric Design for values of coefficient of deceleration in other road conditions.</p> | <p>Coefficient of Deceleration</p> |
| <p>5. Refer to Table 5.5 and Table 5.6 of AUSTRROADS Geometric Design for the stopping sight distances of cars and trucks respectively.</p> | <p>Car and Truck SSD</p> |
| <p>6. Unless travel speeds have been reduced by Horizontal Alignment or other factors, Vertical Curves should always be designed to provide suitable sight distance when travelling at the mandatory speed limit for the road. Formal approval must be obtained from the local Traffic Committee before Council will consent to reducing the mandatory speed limit for a public road.</p> | |
| <p>7. Safe intersection sight distance is applicable at all intersections associated with a development. Refer to AUSTRROADS Guide to Road Design Part 4A Section 3.2.2.</p> | <p>Safe Intersection Sight Distance</p> |
| <p>8. At all intersections, three types of sight distance must be considered in addition to Stopping Sight Distance:</p> <ul style="list-style-type: none"> • Approach Sight Distance (ASD) • Safe Intersection Sight Distance (SISD) • Minimum Gap Sight Distance (MGSD) | |
| <p>9. ASD is the minimum sight distance for drivers on the minor road to be aware of an intersection. It is measured from a driver's eye height (1.1 m) to 0 m to ensure that drivers can observe any pavement markings. Refer to Section 3.2.1 of AUSTRROADS Guide to Road Design Part 4A for additional details.</p> | <p>Approach Sight Distance</p> |
| <p>10. SISD is the minimum sight distance for drivers on the major road to see a vehicle on the minor road. It is measured from a driver's eye height (1.1 m) to a height of 1.25 m above the road. Refer to Section 3.2.2 of AUSTRROADS Guide to Road Design Part 4A for additional details.</p> | <p>Safe Intersection Sight Distance</p> |
| <p>11. MGSD is the minimum distance for critical acceptance that drivers take when crossing or turning at intersections. It is measured from a driver's eye height</p> | <p>Minimum Gap Sight Distance</p> |

(1.1 m) to a height 0.65 m above the road. This is the typical height of a vehicle indicator light. Refer to Section 3.2.3 of AUSTRROADS Guide to Road Design Part 4A for additional details.

- 12 For upgrade and downgrade corrections to ASD and SISD for cars, refer to Table 3.4 of AUSTRROADS Guide to Roads Design Part 4A.

***Grade
Correction***

D1.24 HORIZONTAL AND VERTICAL ALIGNMENT

1. Horizontal and vertical curves are to be designed generally to the requirements of the Transport for NSW technical references. These requirements are essential to satisfy the safety and performance of proper road design. Roads having both horizontal and vertical curvature should be designed to conform to the terrain to achieve desirable aesthetic quality and being in harmony with the landform.

D1.25 INTERSECTIONS

1. Intersections shall be designed in accordance with Transport for NSW technical references (AUSTRROADS Guide to Road Design Part 4: Intersections and Crossings and AUSTRROADS Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings Management). Generally, intersections with existing main and local roads will conform to the layouts shown in Figure D1.6 below. The type of intersection required will depend on existing and planned connecting roads.

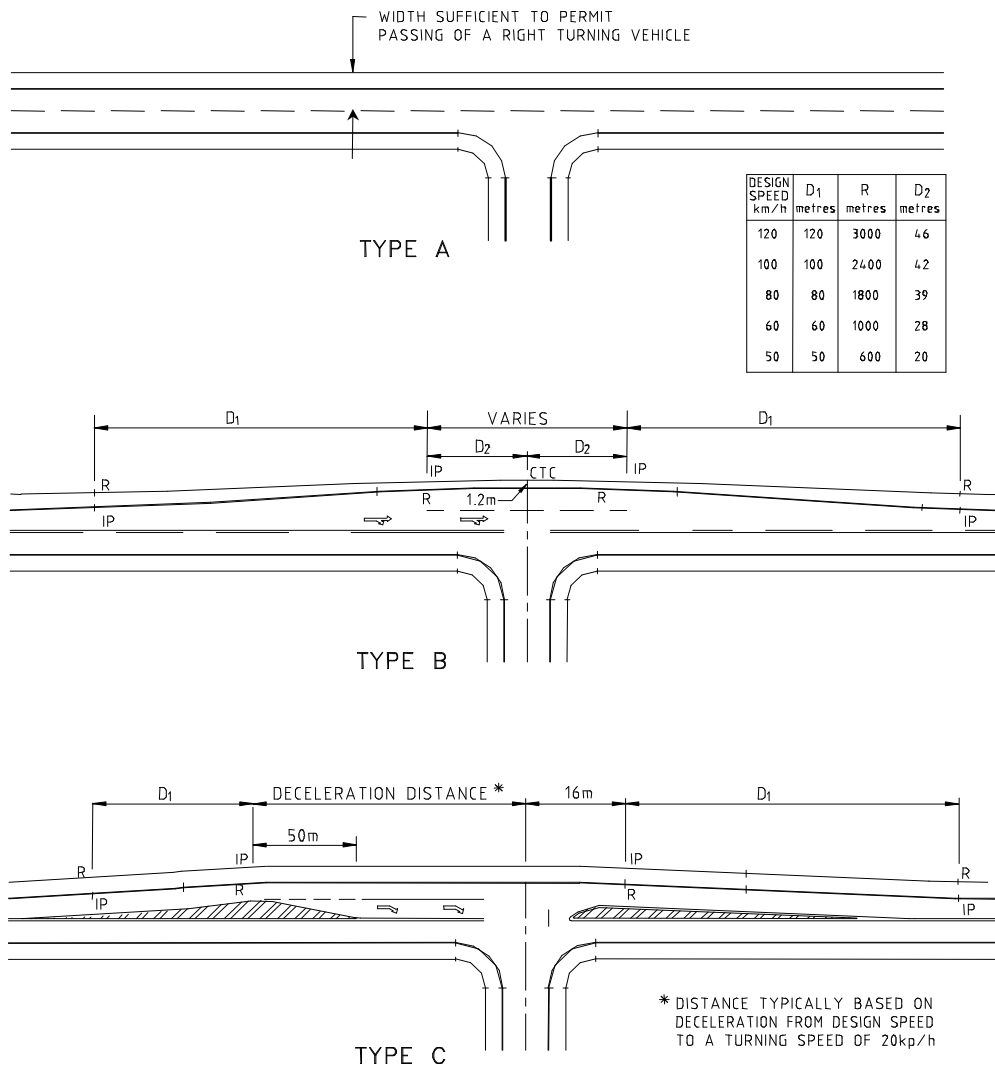


Figure D1.6 Typical Rural Intersection Treatment

Source: AUSTRROADS Guide to Traffic Engineering Practice PART 5, Intersections at Grade.

2. Adequate sight distance should be provided at intersections and junctions. The safe intersection sight distances must be provided in accordance with Transport for NSW technical references.

3. An absolute minimum spacing of 40 m should be adopted for staggered junctions. The intersection angle between two roads should be 90°, and variations to this 90° angle within a tolerance of ± 20° may be permitted.

Staggered Junctions

D1.26 PLAN TRANSITIONS

1. A plan transition is the length over which widening and shift is developed from the "tangent-spiral" point to the "spiral-curve" point; ie, the length between the tangent and the curve. In urban road design it is often impracticable to use plan transitions as kerb lines are fixed in plan and any shift requires carriageway widening. Widening on horizontal curves compensates for differential tracking of front and rear wheels of vehicles; overhang of vehicles; and transition paths. Where proposed roads are curved, the adequacy of carriageway width should be considered.

Widening of Curves

2. Abrupt changes in crossfall, can cause discomfort in travel and create a visible kink in the road edge. A rate of change of road edge of no more than 0.5 per cent relative to the centre line should ensure against this. The wider the pavement the longer the transition. Superelevation transitions should be used at all changes in crossfall, not just for curves. Drainage problems can arise with superelevation transitions that may require extra gully pits and steeper gutter crossfalls. Where crossfalls change at intersections, profiles of the road edge should be drawn. Calculated points can be adjusted to present a smooth curve.

Crossfall Changes

D1.27 CARRIAGEWAYS

1 The carriageway width for new rural roads should generally be as per Table D1.6 below:

**Table D1.6 CHARACTERISTICS OF RURAL ROADS
IN WOLLONDILLY SHIRE COUNCIL ROAD NETWORKS**

ROAD CATEGORY	ROAD RESERVE WIDTH (m)	SEALED CARRIAGEWAY (m)	SHOULDER WIDTH (m) [^]
Cat. G1 Rural Residential Cul-de-sac upto 10 lots	20	4.0	1.0 m sealed 0.5 m unsealed
Cat. G2 Rural Residential Cul-de-sac upto 30 lots	20	6.0	1.0 m sealed 0.5 m unsealed
Cat. G2 Rural Residential upto 100 lots	20	6.0	1.0 m sealed 0.5 m unsealed
Cat. G3 Rural Residential in R5 land zone (Where approved by Council)	20	6.0-8.0	Kerb and Gutter OR Concrete Edge and swale drain
Cat. H Rural Residential >100 lots and Major Collector	20	7.0	1.0 m sealed 0.5 m unsealed
* Single lane treatment (4m) of minor cul-de-sacs will only be considered where site conditions are suitable. Sections of road with steep gradients or limited site distances would not be suitable for single lane treatment.			
[^] A shoulder shall be included on both sides of the rural road. The shoulder will be 1.5 m wide, of which 1.0 m is sealed and 0.5 m is unsealed.			
Refer to Drawing No. WSC.D1.1 for Typical Cross Sections.			

D1.28 SUPERELEVATION

1. Use of maximum superelevation will be considered where the radius of the curve is approaching the minimum speed environment. Calculations for Superelevation should be made with reference to Transport for NSW technical references.

Design Speed

D1.29 SCOUR PROTECTION

1. Scour protection of roadside drainage and table drains is required. The level of protection will depend on the nature of the soils, road gradients and volume of stormwater runoff. Protection works may involve concrete lined channels, kerb and gutter, turfing, rock pitching, check dams, grass seeding, individually or any combination of these. Geotechnical investigations should be carried out to determine the level and extent of any protection works prior to proceeding to final design stage.

2. Council will require concrete lined table drains or standard kerb and gutter to be constructed where flow velocities exceed or are equal to 2m/s and/or longitudinal table drain grades exceed or are equal to 10%.

3. The use of 'V' table drains are discouraged due to the adverse scouring potential due to longitudinal grade. Flat bottomed drains reduce scour and are safer for errant vehicles. Hence, flat bottomed table drains are preferred.

*Flat Bottomed
Drains*

SPECIAL REQUIREMENTS**D1.30 CUT/FILL ROAD BATTERS**

1. Batters shall be to a maximum slope of 1 in 2 for batters in excess of 0.6 metres high, otherwise the maximum batter gradient is 1 in 4. Batters which extend into areas prone to inundations are to be not steeper than 1 in 6. Fill batters shall not straddle allotment boundaries unless appropriate easements for support are created on the affected lot(s). Cut batters shall not straddle allotment boundaries unless letters are obtained for all affected property owners consenting to the proposed work on their property

2. Batters steeper than 1 in 2 may be approved subject to Geotechnical advice, otherwise the batters need to be retained

3. Stabilisation of batters by vegetation shall commence immediately following completion of bulk earthworks. Benching shall be required where any proposed free standing batter exceeds 2.5m. The minimum width of benching shall be 1.0m with a minimum slope of 1 in 100 towards the lower face. The benching shall be vegetated to prevent erosion.

D1.31 HALF ROAD CONSTRUCTION

1. Where a new road straddles a property boundary and Council has approved half width road pavement construction, construction shall include half the actual width plus 1.0 metre.

D1.32 ROAD WIDENING

- 1 Widening of an existing road pavement may be necessary in order to:
 - ensure the public road servicing the development is of an appropriate standard,
 - provide an auxiliary lane to permit safe access/egress for the development,
 - provide for on-street parking or service vehicle bays.
- 2 Where road widening is required, the strength and vertical alignment of the existing road pavement must be considered. Any unsatisfactory sections of existing road pavement between the centreline and edge of road should be removed and reconstructed.
- 3 The new pavement base layer shall be keyed in by extending a minimum 150mm over the existing pavement.
- 4 The new seal should extend a minimum of 150mm over the existing pavement to protect the joint, however it may be necessary to extend the seal up to the road centreline to avoid irregularities in the wearing course.
- 5 Where a new Asphaltic Concrete wearing course is placed adjacent to an existing sprayed seal, the joint shall be sealed with an approved bituminous crack sealant. Council may approve an unsealed joint if it is considered to have a low risk of moisture penetration.

D1.33 RECONSTRUCTING AN EXISTING ROAD

- 1 It may be necessary to reconstruct an existing public road where:
 - the existing pavement is not of a suitable standard to service the traffic generated by the development.
 - the additional traffic loads as a consequence of the development would significantly reduce pavement life.
 - crossfalls in the existing pavement create difficulties for vehicular access/egress.
- 2 Where existing roads are to be reconstructed, the cross sections and long sections should extend at least 20 metres beyond the proposed extent of works. This is to ensure a smooth transition from the existing road to the reconstructed road.
- 3 Designs must include both sides of the road to ensure design levels are appropriate.

D1.34 STREET FURNISHING

- 1 Speed, warning and regulatory signs shall be installed to conform with AS 1743. Pavement linemarking shall meet the requirements of AS 1742.2.
- 2 Street name signs shall be provided for each street in accordance with drawing WSC.D1.14 in the appendix. Street sign poles to be offset from the kerb in accordance with AS 1743. Sign blades are to not overhang the kerb.
- 3 Safety Barriers shall be erected where required by Transport for NSW technical references.

**Signs &
Pavement
Marking**

4 Road edge guideposts should be provided at all locations where concrete kerb and gutter is not constructed e.g half road construction, tapers, rural road and end of roads.

5 Any proposed feature walls marking the entry to a subdivision must be designed giving due regard to:

- structural adequacy
- pedestrian safety and convenience
- vehicle safety (sight distance)
- access to services and utilities
- aesthetics and visual amenity
- economy (low maintenance, anti-graffiti materials).

1.35 SERVICE VEHICLES

1. Measures must be included in the design of any subdivision to provide for service vehicles, such as garbage and effluent trucks. Generally, garbage and effluent trucks will not enter private properties and suitable provision must be made to service the properties from the public road. Where site conditions dictate, a sealed service bay/parking bay should be constructed in an appropriate location, approved by Council, to ensure the service vehicles do not obstruct traffic. Dimensions of the service bay/parking bay shall be 15 metres long by 3.0 metres wide with 1:4 tapers.

D1.36 PROPERTY ACCESS

1 Council requires that satisfactory vehicular access can be provided for every lot taking into account the following:

- Physical constraints
- Sight distances
- Access, verge and allotment grading
- Street design / layout
- Minimum depth of cover requirements to underground services
- The functional road hierarchy of the road being accessed.

2 Construction of property accesses will typically be undertaken as part of the development of that lot and not as part of the land subdivision. In situations where:

- Particularly restrictive physical constraints exist, such as limit sight distances, or
- access to a property is by way of a shared right of way,

construction of the property access will be required as part of the land subdivision.

3 For additional details on property entrances and access handles, refer to WSC D13 – Access & Off-street Parking.

D1.37 BOUNDARY FENCES

1. Consideration will be given to the safety aspects of a proposed boundary fencing with respect to impact with an errant vehicle. No horizontal members shall be used in the fence if they in a location where they are capable of piercing a vehicle and cause death or injury to the occupants.

D1.38 STREET LIGHTING

1. Street lighting shall be provided using LED LIGHTING within any subdivision to comply with the current Australian Standards AS1158. Lighting for roads and public spaces shall be certified by an Endeavour Energy Approved design consultant.
2. Designers are to consider the location of light poles with respect to the lighting of paths, street trees, roadside and pedestrian safety and impact on adjacent property owners. Street lighting shall be provided at all road intersections and where directed by Council.
3. Lighting poles shall be Slimline enlarged base with Eden outreach and Ironstone in colour (powder coated). Alternatively, lighting poles may be Slimline base, standard outreach and galvanised or Ironstone in colour (powder coated).

D1.39 STREET TREES

1. The setback from the face of kerb to street trees should be a minimum of 600 mm.
2. At intersections, line of sight should take priority over quantity of trees.
3. Spacing of street trees should consider the location of services, driveways, WSUD elements and other infrastructure such as footpaths and street lighting.
4. A minimum maintenance period of 36 months after planting trees should apply. Maintenance includes, but is not limited to watering, weeding, pruning, mulching and other general maintenance. If any trees need replacing, then maintenance period for that tree begins again when once the new tree has been planted.
5. Tree stock is to meet NATSPEC standards and AS 2303-2018 for landscaping use.
6. For trees adjacent to footpaths, gutter and any other hard surfaces, root control barriers are to be used.
7. Selection of tree species is crucial for minimising disturbance of adjacent road assets. Council has a preferred list of tree species. Refer to the applicable Development Control Plan for this list. Subdivision developments will require a detailed landscaping proposal that outlines the species and location of street trees.
8. Vertical and horizontal clearance shall be considered in the selection of trees. Refer to Table D1.7 for clearance from trees.

Setback

Sight Distance

Maintenance Period

Table D1.7

Asset	Minimum Vertical Clearance	Minimum Horizontal Clearance
Intersections	2.5 m	10 m
Street Lights	-	5 m
Pedestrian Crossing / Ramps	2 m	5 m
Pedestrian Footpaths	2 m	1 m
Cycle Paths	2.5 m	1 m
Kerb and Gutter / Kerb	2.5 m	1.5 m
Parking Areas or Parking Lane	2.5 m	1.5 m
Travel Lanes (low speed ≤60 km/h)	4.5 m	1.5 m
Travel Lanes (higher speed)	4.5 m	See AUSTRROADS
Driveways	2.5 m	1.5 m

STANDARD DRAWINGS

D1.100	LIST OF STANDARD DRAWINGS FOR THIS SECTION		<i>List of Drawings</i>
1.	DRAWING NUMBER	DRAWING DESCRIPTION	
Roads	WSC.D1.3	Cul-de-Sac Head Design Layout for Category A, B, C & F	
	WSC.D1.12	Standard Kerb and Gutters	
	WSC.D1.14	Standard Street Sign Details	
	WSC.D1.24	Sign Post Locations and Sign Plate Details	
	WSC.D1.25	Cul-de-Sac Head Design Layout Sheet 3 for Category G1 & G2 Roads Standard Type A Details	

DESIGN
SPECIFICATION

D2

PAVEMENT DESIGN

Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Wollondilly Shire Council's primary amendments.

Details are provided below outlining the clauses amended from the Wollondilly Shire Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Updated reference to AUSTRROADS	D2.05	M	DC	1/07/22
2	New road categories and ESAs	D2.05	M	DC	1/07/22
3	Updated reference to AUSTRROADS	D2.06	M	DC	1/07/22
4	Updated reference to AUSTRROADS	D2.11	M	DC	1/07/22
5	Removed reference to SR41	D2.12	O	DC	1/07/22
6	Updated surfacing requirements for new road categories	D2.16	M	DC	1/07/22
7	Asphaltic concrete design	D2.19	M	DC	1/07/22
8	Reconstruction of existing pavement	D2.23	A	DC	1/07/22

SPECIFICATION D2 : PAVEMENT DESIGN

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SPECIFICATION D2 : PAVEMENT DESIGN

GENERAL

D2.01 SCOPE

1. The work to be executed under this Specification consists of the design of the road pavement to meet the required design life, based on the subgrade strength, traffic loading and environmental factors, and including the selection of appropriate materials for select subgrade, subbase, base and wearing surface. This design specification does not cover internal or access driveways. Pavement specifications for Internal and access driveways are outlined in WSC.D13 - ACCESS & OFFSTREET PARKING.

Design Criteria

2. The Specification contains procedures for the design of the following forms of surfaced road pavement construction:

***Surfaced
Pavement
Types***

- (a) flexible pavements consisting of unbound granular materials;
- (b) flexible pavements that contain one or more bound layers, including pavements containing asphalt layers other than thin asphalt wearing surfaces;
- (c) rigid pavements (ie. cement concrete pavements);
- (d) concrete or clay segmental block pavements.

3. Consideration to the design of unsealed (gravel) pavements will only be given for minor rural subdivisions/developments in isolated rural areas where the access to the subdivision is via an existing unsealed road.

***Unsealed
Pavements***

D2.02 OBJECTIVES

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

***Pavement
Performance***

2. Information provided by the NSW Government that indicates salinity may occur in parts of the Wollondilly Local Government Area (LGA). This salinity potential is due to inherent characteristics of the Wollondilly LGA landscape. As a result, buildings and other infrastructure in the Wollondilly LGA may be susceptible to salt damage.

Salinity

The applicant must thoroughly investigate the site to determine if there are any salinity issues to be addressed. The designer shall address salinity in their design. Steps taken may include, but are not limited to:

- Minimising depth of excavation/disturbance required for roadworks;
- Minimising infiltration of surface waters by providing adequate sub-soil drainage;
- Provision of adequate drainage for upstream catchments; and
- Use of appropriate materials in construction of roadworks.

Designers should also follow guidelines set out in Department of Infrastructure, Planning and natural Resources (2003) Guide: *Roads and Salinity* (ISBN: 0 73475377 2).

D2.03 REFERENCE AND SOURCE DOCUMENTS**(a) Council Specifications**

- D1 - Geometric Road Design
- D4 - Subsurface Drainage Design
- Wollondilly Shire Council Construction Specification

(b) State Authorities

- Transport for NSW – Sprayed Sealing Guide, 1992.
- Department of Infrastructure, Planning and Natural Resources
- Guide: Roads and Salinity (2003) (ISBN: 0 73475377 2)

(c) Other

- AUSTROADS - Guide to Pavement Technology Part 2: Pavement Structural Design, 2019
- AUSTROADS - Guide to Control of Moisture in Roads.
- C&CAA - T33 - Cement and Concrete Association, T33 - Concrete Street and Parking Area Pavement Design, 1984.
- C&CAA - T35 - Cement and Concrete Association, T35 - Interlocking Concrete Road Pavements, A Guide to Design and Construction, 1986.
- C&CAA – T44 - Cement and Concrete Association, Guide to specifying Concrete Segmental pavers
- C&CAA – T45 - Cement and Concrete Association, Detailing Guide.
- C&CAA – T46 - Cement and Concrete Association, Design Guide to Residential Streets and Roads.
- C&CAA – T51 - Cement and Concrete Association, Concrete Pavement Design for Residential Streets, 1998.
- C&CAA - TN52 - Cement and Concrete Association, TN52 - Single-Lane Concrete Bus Bays, 1984.
- Clay Brick and Paver Institute
 - Design Manual 1 - Clay Segmental Pavements, A Design and Construction Guide for Sites Subjected to Vehicular and Pedestrian Traffic, 1989.

PAVEMENT DESIGN CRITERIA**D2.04 DESIGN VARIABLES**

1. Regardless of the type of road pavement proposed, the design of the pavement shall involve consideration of the following five input variables:

Design Variables

- (a) Design Traffic
- (b) Subgrade Evaluation
- (c) Environment

- (d) Pavement and Surfacing Materials
- (e) Construction and Maintenance Considerations

D2.05 DESIGN TRAFFIC

1. The design traffic shall be calculated based on the following minimum design lives of pavement:

Minimum Pavement Design Life

- (a) Flexible, Unbound Granular - 25years
- (b) Flexible, Containing one or more bound layers - 25 years
- (c) Rigid (Concrete) - 40 years
- (d) Segmental Block - 25 years

2. Design traffic shall be calculated in equivalent standard axles (ESAs) for the applicable design life of the pavement, taking into account present and predicted commercial traffic volumes, axle loadings and configurations, commercial traffic growth and street capacity. For new subdivisions, the design traffic shall take account of both the construction traffic associated with the subdivision development and the in-service traffic. For interlocking concrete segmental pavements, the simplification of replacing ESA's with the number of commercial vehicles exceeding 3 tonne gross contained in C& CAA – Interlocking Concrete Road Pavements is acceptable up to a design traffic of 10⁶. Beyond this, ESAs should be calculated.

Design Traffic

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

Traffic Data

4. In general, reference should be made to Chapter 2 to 11 of AUSTRROADS Guide to Pavement Technology Part 2: Pavement Structural Design for moderate to heavy traffic loading (greater than 10⁵ ESA) and Chapter 12 of AUSTRROADS Guide to Pavement Technology Part 2: Pavement Structural Design for light traffic loading (less than 10⁵ ESA).

Design Traffic Volumes

5. In the absence of other traffic data, the following traffic values (in ESAs) may be taken as a guide to the design traffic, but shall be subject to variation depending on the circumstances for the particular development.

Design ESAs

Street Type	Design ESA
Local Street – Type 1	1 x 10 ⁵
Local Street – Type 2	5 x 10 ⁵
Local Street – Type 3	5 x 10 ⁵
Local Street – Type 4	1 x 10 ⁶
Residential Laneway	1 x 10 ⁵
Local Collector	5 x 10 ⁶
High Street	5 x 10 ⁶
Industrial Street	1 x 10 ⁷
Retail Laneway	2 x 10 ⁶
Sub-Arterial Road	1 x 10 ⁷
Rural Residential – Category G	2 x 10 ⁴
Rural Residential – Other	3 x 10 ⁵

D2.06 SUBGRADE EVALUATION

1. Except where a mechanistic design approach is employed using AUSTRROADS Structural Pavement Design, the measure of subgrade support shall be the California Bearing Ratio (CBR). Where a mechanistic design approach using linear elastic theory is

California Bearing Ratio

employed for flexible pavements, the measure of subgrade support shall be in terms of the elastic parameters (modulus, Poisson's ratio).

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

Design Considerations

- (a) Sequence of earthworks construction
- (b) The compaction moisture content and field density specified for construction
- (c) Moisture changes during service life
- (d) Subgrade variability
- (e) The presence or otherwise of weak layers below the subgrade level.

3. The subgrade Design CBR adopted for the pavement design must consider the effect of moisture changes in the pavement and subgrade during the service life, and hence consideration must be given to the provision of subsurface drainage in the estimation of equilibrium in-situ CBRs, and hence in the design of the pavement structure. Warrants for the provision of subsurface drainage are given in Specification for SUBSURFACE DRAINAGE DESIGN. If subsurface drainage is not provided, then the Design CBR adopted must allow for a greater variability in subgrade moisture content during the service life of the pavement, and hence a Design Moisture Content above the Optimum Moisture Content.

Design CBR

4. The calculation of the Design CBR shall be based on a minimum of three 4 day soaked CBR laboratory samples for each subgrade area, compacted to the relative density specified for construction, and corrected to allow for the effects of subsurface drainage (or lack of), climatic zone, and soil type if appropriate (as per AUSTROADS Guide to Pavement Technology Part 2: Pavement Structural Design) to give an estimated equilibrium in-situ CBR. The Design CBR for each subgrade area is computed by using the appropriate formulae as follows:

Calculation of Design CBR

Design CBR = Least of estimated equilibrium CBRs, for less than five (5) results

Design CBR = 10th percentile of all estimated equilibrium CBRs, for five (5) or more results

= $C - 1.3S$

Where C is the mean of all estimated equilibrium CBRs, and
S is the standard deviation of all values.

5. Where practicable, the Design CBR obtained from laboratory testing should be confirmed by testing performed on existing road pavements near to the job site under equivalent conditions and displaying similar subgrades. Insitu Dynamic Cone Penetrometer testing could be used to compare Design CBR values obtained as per above.

Field Confirmation

6. The pavement design shall include a summary of all laboratory and field test results and assumptions and/or calculations made in the assessment of Design CBR.

Summary of Results

D2.07 ENVIRONMENT

1. The environmental factors which significantly affect pavement performance are moisture and temperature. Both of these factors must be considered at the design stage of the pavement. Reference should be made to AUSTROADS Guide to Pavement Technology Part 2 Pavement Structural Design and to AUSTROADS Control of Moisture in Pavements During Construction.

Reference

2. The following factors relating to moisture environment must be considered in determining the design subgrade strength/stiffness and in the choice of pavement and surfacing materials:

- (a) Rainfall/evaporation pattern
- (b) Permeability of wearing surface
- (c) Depth of water table
- (d) Relative permeability of pavement layers
- (e) Whether shoulders are sealed or not
- (f) Pavement type (boxed or full width)

3. The effect of changes in moisture content on the strength/stiffness of the subgrade shall be taken into account by evaluating the design subgrade strength parameters (ie. CBR or modulus) at the highest moisture content likely to occur during the design life, ie the Design Moisture Content. The provision of subsurface drainage may, under certain circumstances, allow a lower Design Moisture Content, and hence generally higher Design CBR. However, extreme care is to be taken if consideration is given to lowering the design CBR value to account for the possible benefits of sub-surface drainage.

**Evaluate
Design CBR**

4. The effect of changes in temperature environment must be considered in the design of pavements with asphalt wearing surfaces, particularly if traffic loading occurs at night when temperatures are low, thus causing a potential reduction in the fatigue life of thin asphalt surfacing. The effect of overnight changes in temperature environment should also be considered for bound or concrete layers and spray seal designs.

**Temperature
Change**

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

D2.08 PAVEMENT AND SURFACING MATERIALS

1. Pavement materials can be classified into essentially four categories according to their fundamental behaviour under the effects of applied loadings:

**Pavement
Classification**

- (a) Unbound granular materials, including modified granular materials
- (b) Bound (cemented) granular materials
- (c) Asphaltic Concrete
- (d) Cement Concrete

2. Surfacing materials can also be classified into essentially five categories or types:

**Surfacing
Classification**

- (a) Sprayed bituminous seals (flush seals)
- (b) Asphaltic concrete and bituminous microsurfacing (cold overlay)
- (c) Cement Concrete
- (d) Concrete Segmental Pavers (e) Clay Segmental Pavers

3. All pavement materials shall satisfy the requirements of the Wollondilly Shire Council Construction Specification.

4. The street wearing course shall not be considered to provide structural strength.

D2.09 CONSTRUCTION AND MAINTENANCE CONSIDERATIONS

1. The type of pavement, choice of base and subbase materials, and the type of surfacing adopted should involve consideration of various construction and maintenance factors as follows:

- (a) Extent and type of drainage
- (b) Use of boxed or full width construction
- (c) Available equipment of the Contractor
- (d) Use of stabilisation
- (e) Aesthetic, environmental and safety requirements
- (f) Social considerations
- (g) Construction under traffic
- (h) Use of staged construction
- (i) Ongoing and long-term maintenance costs

These factors are further discussed in AUSTRROADS Structural Pavement Design.

PAVEMENT THICKNESS DESIGN

D2.10 PAVEMENT STRUCTURE - GENERAL

1. The pavement thickness, including the thickness of surfacing, shall not be less than 300mm.

**Minimum
Pavement
Thickness**

2. Notwithstanding subgrade testing and subsequent pavement thickness design, the minimum thickness of subbase and base layers shall be as follows:-

- (a) Flexible pavement: Subbase 175mm, Base 125mm
- (b) Rigid pavement: Subbase 100mm, Base 150mm

3. The subbase layer shall extend a minimum of 150 mm behind the rear face of any kerbing and/or guttering.

Subbase Extent

4. The base and surfacing shall extend to the face of any kerbing and/or guttering. Where the top surface of the subbase layer is below the level of the underside of the kerbing and/or guttering, the base layer shall also extend a minimum of 150mm behind the rear face of the kerbing and/or guttering.

Base Extent

5. For unkerbed roads, the subbase and base layers shall extend at least to the nominated width of shoulder.

D2.11 UNBOUND GRANULAR FLEXIBLE PAVEMENTS (BITUMINOUS SURFACED)

1. Unbound granular flexible pavements with thin bituminous surfacing, including those with cement or lime modified granular materials, with design traffic up to 10⁵ ESAs shall be designed in accordance with AUSTRROADS Guide to Pavement Technology Part 2: Pavement Structural Design Figure 12.2.

2. For design traffic above 10⁵ ESAs, the design shall be in accordance with AUSTRROADS Guide to Pavement Technology Part 2: Pavement Structural Design Figure 8.4. .

D2.12 FLEXIBLE PAVEMENTS CONTAINING BOUND LAYERS (BITUMINOUS SURFACED)

1. Flexible pavements containing one or more bound layers, including cement stabilised layers or asphaltic concrete layers other than thin asphalt surfacing, shall be designed in accordance with AUSTRROADS Structural Pavement Design.

D2.13 RIGID PAVEMENTS

1. Rigid (concrete) pavements, with design traffic up to 10^6 ESAs shall be designed in accordance with either C&CAA –T33 or AUSTRROADS Structural Pavement Design.

***Rigid
(Concrete)***

2. Rigid (concrete) pavements for design traffic above 10^6 ESAs, the design shall be in accordance with AUSTRROADS Structural Pavement Design.

3. Single lane concrete bus bays adjacent to a flexible pavement shall be designed in accordance with C&CAA -TN52.

D2.14 CONCRETE SEGMENTAL BLOCK PAVEMENTS

1. Concrete segmental block pavements with design traffic up to 10^6 estimated commercial vehicles exceeding 3T gross shall be designed in accordance with C&CAA – T35.

***Concrete
Segmental
Block***

2. For design traffic above 10^6 estimated commercial vehicles exceeding 3T gross the design shall be in accordance with AUSTRROADS Structural Pavement Design, with the calculation of design traffic in terms of ESAs.

3. A concrete pavement should be designed below the segmental pavers in accordance with the design method for rigid pavements. The thickness and any structural strength of the pavers should not be considered as a part of the overall thickness and strength of the pavement. Mine subsidence areas may prevent the use of concrete pavements. This needs to be discussed with council.

Concrete Base

D2.15 CLAY SEGMENTAL BLOCK PAVEMENTS

1. Clay segmental block pavements with design traffic up to 10^6 ESAs shall be designed in accordance with Design Manual 1 - Clay Segmental Pavements.

***Clay Segmental
Block***

2. For design traffic above 10^6 ESAs and up to 10^7 ESAs the design shall involve consideration of both Design Manual 1 - Clay Segmental Pavements and AUSTRROADS Structural Pavement Design, with the thicker and more conservative design of each of the two methods adopted.

3. For design traffic above 10^7 ESAs, the pavement shall be designed in accordance with AUSTRROADS Structural Pavement Design.

SURFACING DESIGN**D2.16 CHOICE OF SURFACE TYPE**

1. Except where the pavement is designed for concrete or segmental block surfacing, the wearing surface shall be a bituminous wearing surface as follows:

***Bitumen
Wearing
Surface***

Road Type	Primer	Flush Seal	AC Minimum Thickness	AC Size
Local Street – Type 1	Y	10 mm one coat flush seal	40 mm	AC10
Local Street – Type 2	Y	10 mm one coat flush seal	40 mm	AC10
Local Street – Type 3	Y	10 mm one coat flush seal	40 mm	AC10
Local Street – Type 4	Y	10 mm one coat flush seal	40 mm	AC10
Residential Laneway	Y	10 mm one coat flush seal	40 mm	AC10
Local Collector	Y	10 mm one coat flush seal	50 mm	AC14
High Street	Y	10 mm one coat flush seal	50 mm	AC14
Industrial Street	Y	10 mm one coat flush seal	50 mm	AC14
Retail Laneway	Y	10 mm one coat flush seal	40 mm	AC10
Sub-Arterial	Y	10 mm one coat flush seal	50 mm	AC14
Rural Cat G	Y	14 mm/10 mm two coat flush seal	-	-
Rural Cat H	Y	14 mm/10 mm two coat flush seal	-	-
All Intersections	Y	10 mm one coat seal	50 mm	AC14/AC10
Cul-de-sac turning circles and turning heads	Y	10 mm one coat seal	50 mm	AC14/AC10
Roundabouts	Y	10 mm one coat primer seal	80 mm	AC14 SBS polymer modified asphalt

2. At intersection approaches and cul-de-sac turning circles on residential streets with flush seals, asphalt surfacing shall be provided within the vehicle braking and turning zones.

Braking and Turning Zones

3. Where only shoulder widening works are proposed, per the road category, the respective thickness and size of asphalt may be laid directly on the primer with no 10 mm flush seal.

Shoulder Widening

4. Thickness of asphaltic concrete within cul-de-sac turning circle and turning heads shall be minimum 50 mm AC10 or AC14 laid on a single coat seal of 10 mm aggregates.

Cul-de-sac

5. Roads with longitudinal gradient more than 16.67% shall be sealed with asphaltic concrete with single coat seal of 10 mm aggregates underneath.
6. Variations to these requirements may be approved in special circumstances.

D2.17 SPRAYED BITUMINOUS SEALS (FLUSH SEALS)

1. The design of sprayed bituminous (flush) seals, including primers and primer seals, shall be in accordance with the TfNSW Sprayed Sealing Guide. **Seal Design**
2. A 7mm or 10mm primer seals shall be indicated on the Drawings below all flush seals, and asphalt surfacing. **Primer Seal**
3. Two-coat flush seals shall be double-double seals, comprising a minimum of two (2) coats binder and two (2) coats of aggregate. The preferred seal types are: **Two- Coat Flush Seals**

1st coat	14mm
2nd coat	7/10mm
4. Single coat flush seals shall be allowable if asphaltic concrete is to be applied as the finished surface. The preferred seal type is 10mm. **Single Coat Flush Seal**

D2.18 BITUMINOUS MICROSURFACING (COLD OVERLAY) DELETED

D2.19 ASPHALTIC CONCRETE

1. In light to medium trafficked residential, rural or commercial streets (design traffic up to approximately 1×10^5 ESAs), the asphalt mix design shall be in accordance with Chapter 12 of AUSTRROADS Guide to Pavement Technology Part 2: Pavement Structural Design and the Wollondilly Shire Council Construction Specification. **Light to Medium Traffic**
2. In medium to heavily trafficked residential, rural or commercial roads (design traffic greater than 1×10^5 ESAs) and in all industrial and classified roads, the asphalt mix design shall be a dense graded mix in accordance with the Wollondilly Shire Council Construction Specification. **Medium to Heavy Traffic**
3. Asphaltic concrete wearing surface shall be designed to provide a nominal compacted layer thickness of not less than 40mm on light to medium trafficked residential, rural and commercial streets, and 50mm on medium to heavily trafficked residential, rural or commercial roads and on all industrial and classified roads. **Minimum Thickness**
4. As a minimum, a 7mm or 10mm primer seal shall be indicated on the Drawings below the asphalt surfacing. **Primer Seal**
5. On roundabout pavements for all classes / categories of roads, the surface shall have a minimum compacted layer thickness of 80mm AC14 SBS polymer modified Asphalt on a single 10mm primer seal. The approaches to the roundabout for a distance as determined by Council shall also have a minimum compacted layer thickness of 80mm AC14 SBS polymer modified Asphalt on a single 10mm primer seal. **Roundabouts**

D2.21 PERMEABLE PAVEMENTS

1. Concrete permeable pavers are acceptable in private driveways and private/public car parking areas. **Acceptability**
2. The pavement shall be designed and constructed to manufacturer's details incorporating water sensitive urban design (WSUD) principles and shall ensure that the pavement allows infiltration of stormwater. **Manufacture Specifications**

3. The edges of the paving shall be designed to be constrained by either kerbing and/or guttering, or by concrete edge strips.

**Edge
Constraint**

SPECIAL REQUIREMENTS

D2.22 UNSEALED PAVEMENT

1. Consideration to the design of unsealed (gravel) pavements will only be given for minor rural subdivisions/developments in isolated rural areas where the access to the subdivision is via an existing unsealed road.
2. In permitting an unsealed road, factors that will be considered include the potential for dust from the road to adversely impact on existing dwellings or likely future dwellings and issues of erosion and maintenance.
3. Roads with a longitudinal gradient exceeding 10% must be sealed.

D2.23 RECONSTRUCTION OF EXISTING PAVEMENT

1. Where reconstruction of existing pavement is proposed, subgrade investigation should be in accordance with AUSTRROADS Guide to Pavement Technology Part 2 Pavement Structural Design.
2. If the CBR is less than 3.0, the subgrade should be stabilised or replaced to provide a minimum CBR of 3.0.

Reference

Minimum CBR

STANDARD DRAWINGS

D2.100 LIST OF DRAWINGS

- | 1. | DRAWING NUMBER | DRAWING DESCRIPTION |
|----|----------------|---------------------|
| | WSC.D2.2 | Deleted |

**List of
Drawings**

DESIGN
SPECIFICATION

D3

**STRUCTURES/
BRIDGE DESIGN**

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font. The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Removed reference to timber	D3.02	O	DC	1/07/22
2	Structural Certification	D3.05	A	DC	1/07/22
3	Reference to D6 Site Grading	D3.07	A	DC	1/07/22

SPECIFICATION D3 : STRUCTURES/BRIDGE DESIGN
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SPECIFICATION D3 : STRUCTURES/BRIDGE DESIGN

GENERAL

D3.01 SCOPE

1. This section sets out design considerations to be adopted in the design of structural engineering elements for land subdivisions. Such activities will include:

- Road traffic bridges
- Pedestrian bridges
- Structures other than bridges, but associated with roads (eg retaining walls)
- Small earth dams, detention basins
- Structures used for public safety (traffic barriers, pedestrian barriers, street lighting)
- Major sign support structures
- Temporary works

Such structures may be of concrete, timber or steel constructions, but with emphasis placed on low maintenance.

D3.02 OBJECTIVE

1. The aim of design shall be the achievement of acceptable probabilities that the structure being designed will not become unfit for use during its design life, having regard to economic, physical, aesthetic and other relevant constraints.
2. The Design Life of structures must comply with Council's Asset Management Plan. Where no specific design life is specified in the Plan, the following shall be used:
 - a. Road and Pedestrian Bridge – 100 years
 - b. Deck/boardwalk (require Council approval) – 50 years
 - c. Retaining Walls – 80 years
 - d. Small earth dams and detention basins – 80 years
 - e. Structures for Public Safety – 80 years
 - f. Major sign support – 50 years

Design Life

D3.03 BASES OF DESIGN

1. The design shall be based on scientific theories, experimental data and experience, interpreted statistically as far as possible. The safety and service performance of a structure depends also on the quality control exercised in fabrication, supervision on site, the control of unavoidable imperfections and the qualifications, experience and skill of all personnel involved. Adequate attention shall therefore be given to these factors. In addition, adequate management control and supervision by experienced engineers shall be required at all stages of design and construction to prevent the occurrence of gross errors.

***Safety Quality
Qualifications***

2. Specifications shall be notated on the design plans with sufficient detail to ensure that the above described strategies are able to be effectively implemented at the construction stage.

D3.04 REFERENCE AND SOURCE DOCUMENTS**(a) Council Specifications**

- D1 - Geometric Road Design
- D5 - Stormwater Drainage Design

(b) Australian Standards

- AS1170 - Minimum design loads on structures (SAA Loading Code)
 - AS1684 - National Timber Framing Code
 - AS3600 - Concrete structures
 - AS3700 - Masonry in buildings (SAA Masonry Code)
 - AS4100 - Steel structures
 - AS5100 - Bridge Design Code
- Other relevant codes and guidelines with the above.

(c) Other

- AUSTROADS - Bridge Design Code
- Inst. of Eng. - Australian Rainfall and Runoff
- KD Nelson - Design and Construction of Small Earth Dams

D3.05 ROAD TRAFFIC BRIDGES

1. Structural design of bridges is a complex matter generally falling outside the scope of many small civil engineering consultancies. Council would generally prefer this work to be referred to a firm whose A.C.E.A. listing includes structural design of bridges in its claimed area of competency. **A.C.E.A. Listing**
2. However, this does not preclude submissions by other qualified persons in which cases Council reserves the right to call for evidence of the qualifications and experience of the responsible designer; or to seek referral of the design calculations to an appropriate A.C.E.A. firm for checking. The latter requirement will be at the proponents cost, if directed. **Checking**
3. The Austroads Bridge Design Code is the appropriate general reference for bridge proposals. **Design Code**
4. Council normally requires bridges to have low maintenance finishes; therefore timber and steel are not usually acceptable construction materials, unless suitable precautions are adopted. Heavy debris and bed loads may be characteristic of some streams so that large spans with slender piers are encouraged. If overtopping is permitted, handrails and guardrails are usually omitted. Flood depth indicators will be provided in such cases. **Debris**
Overtopping
5. Preventive maintenance is a key issue affecting the design life of the structure. The design plans shall specify the design life of the structure together with the relevant maintenance programs to be adopted upon which the design life is based. Parameters used in the design shall also be shown on the design plans. **Design Life**
Maintenance
6. Unless otherwise indicated on the Development Application, bridges over small watercourses within the development shall be designed with appropriate afflux to convey the 20% AEP storm event with certification stating that the bridge is capable of withstanding the inundation loadings for up to the 1% AEP storm event. If in the opinion of the designer, such certification is impractical, the structure shall be designed to convey the 1% AEP storm event without inundation. **Small Bridges**
Design Storm Event
7. Where structures are designed to be inundated, the effect of the backwater gradient on upstream property shall be identified on the design plans.

- | | | |
|-----|--|--------------------------------|
| 8. | Bridges located in roadways which are to be dedicated as public roads shall be designed to convey the stormwater event identified in the drainage design specification. Where no inundation is permitted, appropriate afflux shall be adopted together with a 500mm freeboard to the underside of the bridge deck. | <i>Freeboard</i> |
| 9. | Designers should enquire regarding current or likely provision for public utilities in bridges. | <i>Public Utilities</i> |
| 10. | Structures to be designed for a minimum load of 42 tonne vehicle. | |
| 11. | The design and construction of structures to be certified by a suitably qualified structural engineer. | |

D3.06 PEDESTRIAN BRIDGES

- | | | |
|----|--|-------------------------------------|
| 1. | Provision for pedestrians on bridges is required in rural residential as well as urban areas. The minimum provision is a 1.5m footpath with kerb at the road traffic edge and handrail. | <i>Pedestrians</i> |
| 2. | Council may require the provision of separate pedestrian carriageways in other situations should the anticipated traffic warrant it. Urban bridge approaches should be lit. A continuous accessible path of travel shall be provided in the design | <i>Accessible Path</i> |
| 3. | Designers should enquire regarding the current and future utility services which the bridge may be required to carry. These should be concealed for aesthetic reasons. | <i>Carriage of Utilities</i> |
| 4. | Materials used for a pedestrian bridge, deck or boardwalk shall be durable and low maintenance. Use of timber structures will generally not be accepted by Council and will require prior Council approval before acceptance. | <i>Materials</i> |

D3.07 STRUCTURES OTHER THAN BRIDGES, ASSOCIATED WITH ROADS AND SUBDIVISION

- | | | |
|----|--|-------------------------|
| 1. | Public utility structures, retaining walls, and the like will be designed by a competent, practicing engineer, accredited in the design of such structures. The consultant shall refer to the Austroads code and any other Australian standards to execute the design. | |
| 2. | Retaining walls that are constructed within road reserve or public land shall be constructed of reinforced concrete, masonry, concrete block or stone. Retaining walls that are constructed within private land but support road or public infrastructure shall be constructed of reinforced concrete, masonry, concrete block or stone. | <i>Materials</i> |
| 3. | Retaining walls that are used to support land regrading works and that extend along more than one lot shall be constructed of reinforced concrete, masonry, concrete block or stone. Additional details in WSC D6 Site Grading. | |
| 4. | Retaining structures including footings and drainage structures shall be constructed wholly within the subject property. | <i>Location</i> |

D3.08 SMALL EARTH DAMS/DETENTION BASINS

- | | | |
|----|--|-----------------------|
| 1. | Small earth dams may be designed following the guidelines in "Design and Construction of Small Earth Dams" by K D Nelson together with relevant geotechnical recommendations. The structural design of weir outlets to resist failure shall be considered in design. Refer also to the Retarding Basin and Stormwater Detention sections in the Specification for STORMWATER DRAINAGE DESIGN D5. | |
| 2. | Childproof fencing shall be nominated where unacceptable risk exists due to the location of the dam/basin in relation to the urban nature of the area. The degree of risk is typically dependant on the grades of the land adjacent to the edge of the water and | <i>Fencing</i> |

progressing into deeper water. Childproof fences will generally be required around dams and other water bodies in urban areas where the following criteria cannot be satisfied:

Approach Grade to Maximum Depth	Maximum Depth (m)
Greater than 1:4	0.3
1:4 to 1:15	0.8
Less than 1:15	No Maximum

Notwithstanding the above, Council may require safety fences around water bodies where, due to the nature of the landuse in the proximity of the waterbody, it is considered that there is an unacceptable risk to children.

3. The consultant shall carry out the design with recognition of the potential risk on existing and planned infrastructure downstream, assuming the probability of dam/basin failure.

4. The consultant shall be a qualified civil or structural engineer having accreditation in the design of such structures.

Qualification

5. The consultant shall be required to certify the design and ultimately certify the work-as-executed plans for compliance with the design. All relevant details shall be shown on the design plans.

D3.09 STRUCTURES USED FOR PUBLIC SAFETY

1. Since the requirement of traffic barriers and pedestrian safety rails on bridges are different, the design engineer shall consider whether separate traffic and pedestrian barriers can be detailed to satisfy the major functional requirements.

Barriers

2. The Austroads Bridge Design Code is the recommended reference in this regard.

3. It is essential that all barriers have been fully tested and accredited for the intended use under quality assurance provisions.

4. Urban and rural residential bridge crossings shall be provided with adequate streetlighting. Such requirements will be noted accordingly on the design plans.

Lighting

D3.10 TEMPORARY WORKS

1. Structures which are proposed for the temporary support of roads, services and the like shall be designed by a qualified Engineer experienced and accredited in the design of such structures. A construction programme, indicating the sequence of events leading to the implementation and removal of the temporary structures shall be specified on the design plans.

Programme of Temporary Provisions

STANDARD DRAWINGS

D3.100 LIST OF DRAWINGS

List of Drawings

1.	DRAWING NUMBER	DRAWING DESCRIPTION
	WSC.D3.1	Rock Retaining Wall

DESIGN
SPECIFICATION

D4

**SUBSURFACE
DRAINAGE DESIGN**

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

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Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Additional subsoils on WAE drawings	D4.05	A	DC	1/07/22
2	Geotextile coverage over filter material	D4.13	A	DC	1/07/22

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SPECIFICATION D4 : SUBSURFACE DRAINAGE DESIGN

GENERAL

D4.01 SCOPE

1. The work to be executed under this Specification consists of the design of the subsurface drainage system for the road pavement and/or subgrade.
2. This specification contains procedures for the design of subsurface drainage, including:
 - (a) Subsoil and Foundation Drains
 - (b) Sub-Pavement Drains
 - (c) Drainage Mats, including Type A and Type B Mats.
3. Reference guidelines for the application and design of subsurface drainage include ARRB Special Reports 35 and 41, and the AUSTROADS publication – Guide to the Control of Moisture in Roads. The full titles of these guidelines are given below.

D4.02 OBJECTIVES

1. The objective in the design of the subsurface drainage system is to control moisture content fluctuations in the pavement and/or subgrade to within the limits assumed in the pavement design. **Control Moisture Content**
2. Information provided by the NSW Government that indicates salinity may occur in parts of the Wollondilly Local Government Area (LGA). This salinity potential is due to inherent characteristics of the Wollondilly LGA landscape. As a result, buildings and other infrastructure in the Wollondilly LGA may be susceptible to salt damage. **Salinity**

The applicant must thoroughly investigate the site to determine if there are any salinity issues to be addressed. The designer shall address salinity in their design. Steps taken may include, but are not limited to:

- Minimising depth of excavation/disturbance required for roadworks;
- Minimising infiltration of surface waters by providing adequate sub-soil drainage;
- Provision of adequate drainage for upstream catchments; and
- Use of appropriate materials in construction of roadworks.

Designers should also follow guidelines set out in Department of Infrastructure, Planning and natural Resources (2003) Guide: *Roads and Salinity* (ISBN: 0 73475377 2).

D4.03 TERMINOLOGY

1. Subsoil drains are intended for the drainage of ground water or seepage from the subgrade and/or the subbase in cuttings. **Subsoil Drains**
2. Foundation drains are intended for the drainage of seepage, springs and wet areas within and adjacent to the foundations of the road formation. **Foundation Drains**
3. Sub-pavement drains are intended for the drainage of the base and subbase pavement layers in flexible pavements. They may also function to drain seepage or groundwater from the subgrade. **Sub-pavement Drains**

4. Type A drainage mats are intended to ensure continuity of a sheet flow of water under fills, to collect seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. **Type A
Drainage Mats**
5. Type B drainage mats are constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings. **Type B
Drainage Mats**

D4.04 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specification

- C230 - Subsurface Drainage – General
- C231 - Subsoil and Foundation Drains
- C232 - Pavement Drains
- C233 - Drainage Mats

(b) Australian Standards

- AS2439.1 - Perforated drainage pipe and associated fittings

(c) RMS TfNSW Specifications

- MR Form 1160 - Supply and Delivery of Seamless Tubular Filter Fabric.
- 3555 - Slotted Fibre Reinforced Concrete Pipe for Subsurface Drainage

(d) Other

- AUSTROADS - Guide to the Control of Moisture in Roads, 1983
- ARRB-SR35 - Australian Road Research Board, Special Report No. 35 – Subsurface Drainage of Road Structures, Gerke R.J., 1987.
- ARRB-SR41 - Australian Road Research Board, Special Report No. 41 - A structural Design Guide for Flexible Residential Street Pavements, Mulholland P.J., 1989..

Department of Infrastructure, Planning and Natural Resources
Guide: *Roads and Salinity* (2003) (ISBN: 0 73475377 2)

SUBSOIL AND SUB-PAVEMENT DRAINS

D4.05 WARRANTS FOR USE

1. Subsoil drains are designed to drain groundwater or seepage from the subgrade and/or subbase in cuttings. **Subsoil Drains**
2. Sub-pavement drains are designed to drain water from base and subbase pavement layers in flexible pavements, and to drain seepage or groundwater from the subgrade. **Sub-pavement Drains**
3. Subsoil or sub-pavement drains shall be provided on both sides of the formation in the following locations, unless the geotechnical report indicates the absence of subsurface moisture at the time of investigation and the likelihood that changes in the subsurface moisture environment will not occur within the design life of the pavement and/or the pavement has been specifically designed to allow for likely variations in subgrade and pavement moisture contents: **Geotechnical Survey**

- (a) On the high side of the road and under all kerb if there is no stormwater drainage or approved by council. **Locations**
- (b) Cut formations where the depth to finished subgrade level is equal to or greater than 400mm below the natural surface level.
- (c) Locations of known hillside seepage, high water table or isolated springs.
- (d) Irrigated, flood-prone or other poorly drained areas.
- (e) Highly moisture susceptible subgrades, ie. commonly displaying high plasticity or low soaked CBRs.
- (f) Use of moisture susceptible pavement materials.
- (g) Existing pavements with similar subgrade conditions displaying distress due to excess subsurface moisture.
- (h) At cut to fill transitions.

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

4. The need for subsoil and sub-pavement drains may otherwise become apparent during the construction process, due to changes in site moisture conditions or to areas of poorer subgrade being uncovered that were not identified in the geotechnical investigation. The Design Drawings shall be suitably annotated to the potential need for subsoil or sub-pavement drains in addition to those shown on the Drawings. Any additional subsoil drains should be included on the Works-As-Executed drawings.

During Construction

D4.06 LAYOUT, ALIGNMENT AND GRADE

1. Typical cross sections of subsoil and sub-pavement drains are shown below in Figures D4.1 and D4.2. As indicated in these figures, subsoil drain trenches are excavated to below subgrade level, while sub-pavement drains extend into or adjacent to the pavement layers to facilitate drainage of the pavement layers in addition to the subgrade.

Typical Cross Sections

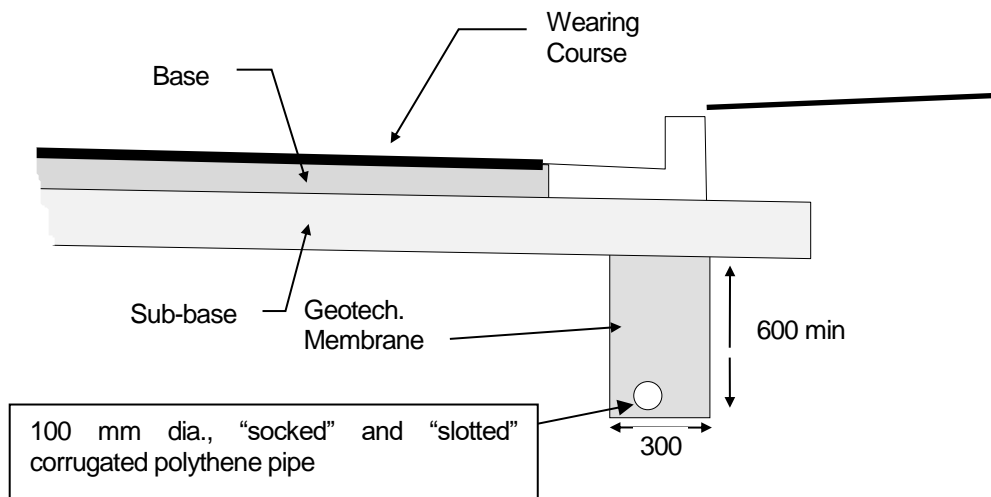


Figure D4.1 - Typical Subsoil Drain Location

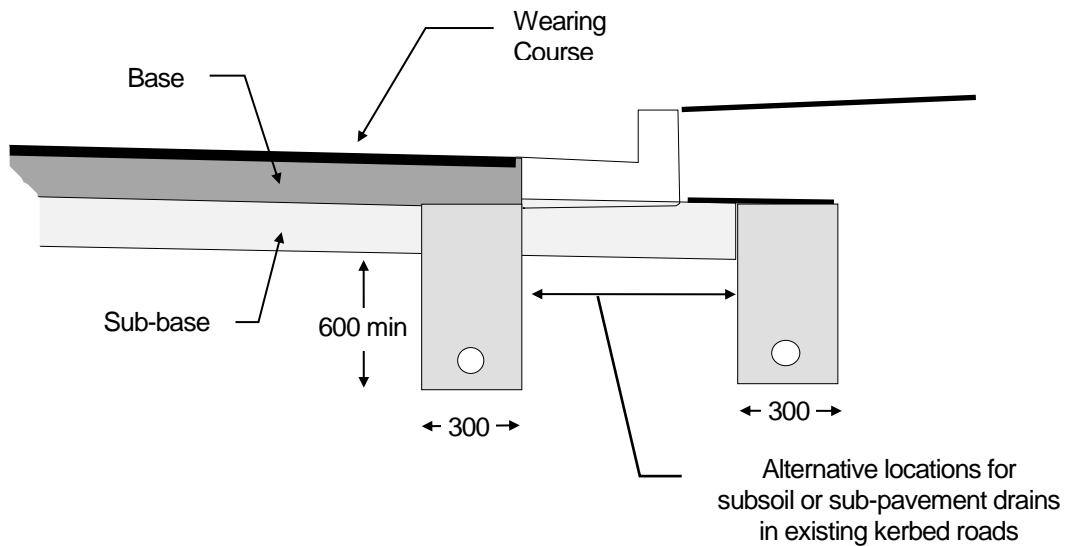


Figure D4.2 - Typical Sub pavement Drain (in existing kerbed road)

- | | |
|---|-------------------------------------|
| <p>2. In existing kerbed roads, the two acceptable alternative locations for the line of the trench are directly in front of or behind the kerblines. Pavement layers must extend to at least the line of the rear of the trench as shown in Figure D4.2.</p> | <p>Existing Kerbed Roads</p> |
| <p>3. In unkerbed roads, subsoil and sub-pavement drains shall be located within the shoulder, preferably at the edge of the pavement layers.</p> | <p>Unkerbed Roads</p> |
| <p>4. The minimum desirable longitudinal design grade shall be 1.0 - 1.5%. For non-corrugated pipes, an absolute minimum grade of 0.5% is acceptable.</p> | <p>Grade</p> |
| <p>5. Trench widths shall be a minimum of 300mm, with a minimum depth below finished subgrade level of 600mm in earth and 450mm in rock, and below the invert level of any service crossings.</p> | <p>Trench Dimensions</p> |
| <p>6. Outlets shall be spaced at maximum intervals of 150 metres. Where possible, subsoil and sub-pavement drainage pipes shall discharge into gully pits or other stormwater drainage structures. Where not possible, outlets shall be provided through fill batters.</p> | <p>Outlets</p> |
| <p>7. Cleanouts are to be provided in accordance with Council drawing WSC.D4.1 at the commencement of each run of drain, and at intervals not exceeding 80 metres. Cleanouts shall generally be located directly at the rear of kerb or at the edge of shoulder, as applicable.</p> | <p>Cleanouts</p> |
| <p>8. The subsoil drainage trench shall be backfilled with average 10 mm aggregates of crushed stone or recycled concrete to the level bottom of the subbase layer.</p> | <p>Fill Material</p> |

FOUNDATION DRAINS

D4.07 WARRANTS FOR USE

- | | |
|---|---|
| <p>1. Foundation drains are designed to drain excessive ground water areas within the foundation of an embankment or the base of cutting, or to intercept water from entering these areas.</p> | <p>Foundation Drains</p> |
| <p>2. The need to provide foundation drains may be apparent from the results of the geotechnical survey along the proposed road formation alignment, and in this case the location shall be shown on the plans. However, more commonly, the need to provide</p> | <p>Geotechnical Survey During Construction</p> |

foundation drains is determined during construction, and hence in this situation requirements and locations cannot be ascertained at the design stage.

3. Where the road formation traverses known swampy, flood-prone, or watercharged strata, the design Drawings shall be suitable annotated to the potential need for foundation drains at various locations, in addition to those shown on the Drawings.

D4.08 LAYOUT, ALIGNMENT AND GRADE

1. Typical cross-sections of foundation drains are shown below in Figure D4.3.

Typical Cross Section

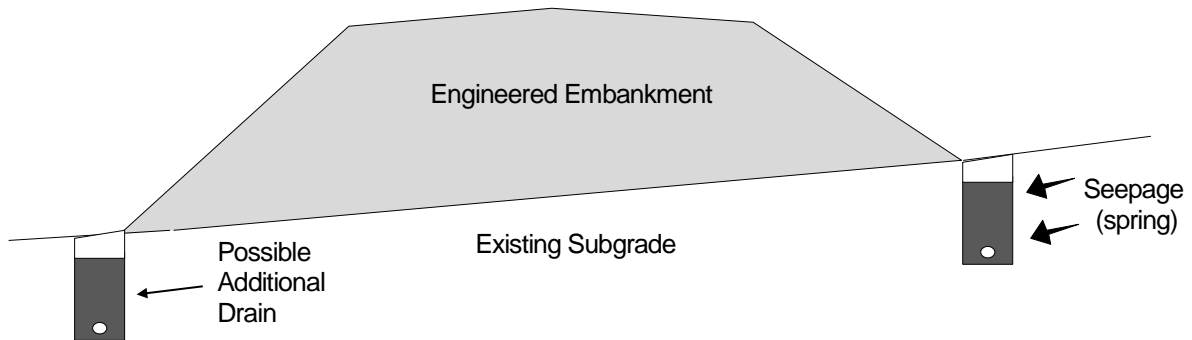


Figure D4.3 - Foundation Drains

2. The minimum desirable design grade shall be 1.0 - 1.5%. For non-corrugated pipes an absolute minimum grade of 0.5% is acceptable.

Grade

3. Foundation drains shall be a minimum trench width of 300mm, with a variable trench depth to suit the application and ground conditions on site.

Trench Dimensions

4. Outlets shall be spaced at maximum intervals of 150 metres.

Outlets

5. Where practicable, cleanouts are to be provided at the commencement of each run of foundation drain and at intervals not exceeding 80 metres. Where not practicable to provide intermediate cleanouts, outlets shall be spaced at maximum intervals of 100 metres.

Cleanouts

DRAINAGE MATS (BLANKETS)

D4.09 WARRANTS FOR USE

1. Type A drainage mats are designed where there is a need to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area, or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water. Type A drainage mats are constructed after the site has been cleared and grubbed and before commencement of embankment construction.

Type A Mats

2. Type B drainage mats are designed where there is a need to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings. Type B drainage mats shall be constructed after completion of the subgrade construction and before construction of the pavement.

Type B Mats

3. The need to design for the provision of drainage mats should be apparent from the result of the geotechnical survey along the proposed road formation alignment.

Geotechnical Survey

MATERIALS

D4.10 SUBSOIL AND SUB-PAVEMENT DRAIN PIPE

1. Pipes designated for subsoil, foundation and sub-pavement drains shall be 100mm \varnothing slotted pipe.
2. Corrugated plastic pipe shall be Class 400 (SN8 TfNSW Specification 3552) conforming to the requirements of AS2439.1. Class 1000 (SN20 TfNSW Specification 3552) shall be used where subject to heavy vehicle traffic loads. Joints, couplings, elbows, tees and caps shall also comply with AS2439.1.
3. Slotted fibre reinforced cement pipe shall comply with TfNSW Specification 3555.
4. Slotted rigid UPVC pipe shall be of a type and class approved by Council.
5. All pipe shall be slotted, and fitted with seamless tubular filter fabric complying with MR Form 1160, except for cleanouts and outlets through fill batters which shall be unslotted pipe.

D4.11 INTRA PAVEMENT DRAIN PIPE

1. Pipes for use in Type B Drainage Mats shall be designated 100mm diameter slotted fibre reinforced concrete pipe, meeting the requirements of TfNSW Specification 3555.
2. Pipes for use in intra pavement drains where crushed rock subbase layer thicknesses are greater than 200mm shall be designated 100mm diameter slotted fibre reinforced concrete pipe, meeting the requirements of TfNSW Specification 3555.
3. Pipes for use in for edge drains where any part of the shoulder consists of material other than concrete, and shall be designated 100mm diameter slotted fibre reinforced concrete pipe, meeting the requirements of TfNSW Specification 3555.

D4.12 FILTER MATERIAL

1. The types of filter material covered by this Specification shall include:
 - (a) Type A filter material for use in subsoil, foundation, and sub-pavement (trench) drains and for Type B drainage mats.
 - (b) Type B filter material for use in subsoil, foundation and sub-pavement (trench) drains.
 - (c) Type C filter material comprising crushed rock for use in Type A drainage mats.
 - (d) Type D filter material comprising uncrushed river gravel for use in Type A drainage mats.
2. Material requirements and gradings for each type of filter material are included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.
3. The type of filter material specified to backfill the sub-surface drainage trenches (subsoil, foundation and sub-pavement drains) shall depend on the permeability of the pavement layers and/or subgrade and the expected flow rate. Generally, Type A filter material is used for the drainage of highly permeable subgrade or pavement layers such as crushed rock or coarse sands, while Type B filter material is used for the drainage of

subgrade and pavement layers of lower permeability such as clays, silts or dense graded gravels. Further guidance to the selection of appropriate filter material is contained in ARRB Special Report 35.

D4.13 GEOTEXTILE

1. Where necessary to provide separation (ie. prevent infiltration of fines) between the filter material in the trench and the subgrade or pavement material, geotextile shall be designated to encapsulate the filter material. The geotextile shall comply with the requirements included in the Construction Specification, SUBSURFACE DRAINAGE GENERAL.
2. The geotextile should at a minimum cover the top side of the filter material and extend 100 mm down the sides of the filter material. It should be noted that all 4 sides of the filter material may need to be wrapped with geotextile at the direction of the council engineer, due to the soil conditions.
3. Geotextile shall also be designated for both Type A and Type B Drainage Mats.

STANDARD DRAWINGS

D4.100 LIST OF DRAWINGS

*List of
Drawings*

- | 1. | DRAWING NUMBER | DRAWING DESCRIPTION |
|----|-----------------------|-----------------------------|
| | WSC.D4.1 | Subsoil Drainage Clean Outs |

DESIGN
SPECIFICATION

D5

**STORMWATER
DRAINAGE DESIGN**

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font. The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Water quantity and quality consideration	D5.01	A	DC	1/07/22
2	Reference to Wollondilly Water Sensitive Urban Design Guidelines	D5.03	A	DC	1/07/22
3	ARR 2019 methods and BoM data	D5.04	M	DC	1/07/22
4	Table of IFD values	D5.04	O	DC	1/07/22
5	Minimum fraction impervious	Table D5.1	M	DC	1/07/22
6	Minimum gutter grade	D5.09	A	DC	1/07/22
7	Pit reinforcement requirements	Table D5.3	M	DR	1/07/22
8	Stormwater pit design	D5.10	A	DC	1/07/22
9	Public drainage through private land	D5.12	A	DC	1/07/22
10	Vegetation of exposed batters	D5.15	A	DC	1/07/22
11	Minimum freeboard	D5.16	A	DC	1/07/22
12	Maximum inspection pit interval	D5.17	A	DC	1/07/22
13	Rainwater tank design	D5.26	A	DC	1/07/22
14	Infiltration swale design	D5.26	A	DC	1/07/22
15	Legal point of discharge	D5.27	A	DC	1/07/22
16	OSD requirement	D5.27	A	DC	1/07/22
17	Kerb outlets	D5.27	A	DC	1/07/22
18	Property drainage behind kerb	D5.27	O	DC	1/07/22
19	Open channel discharge protection	D5.27	A	DC	1/07/22

STORMWATER DRAINAGE DESIGN

20	Adsorption trench positive covenant	D5.27	A	DC	1/07/22
21	Requirements for charged lines	D5.27	A	DC	1/07/22
22	General WSUD Requirements	D5.33	M	DC	1/07/22
23	Design of Treatment Devices	D5.34	A	BG	1/07/22
24	Volume Management	D5.35	A	BG	1/07/22
25	Peak Flow Management	D5.36	A	BG	1/07/22
26	Maintenances	D5.37	A	BG	1/07/22

SPECIFICATION D5 : STORMWATER DRAINAGE DESIGN

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SPECIFICATION D5 : STORMWATER DRAINAGE DESIGN

GENERAL

D5.01 SCOPE

1. The work to be executed under this Specification consists of the design of stormwater drainage systems for urban and rural areas.
2. Developments must consider the management of stormwater quantity and quality to ensure minimal impact to the natural and build environment

D5.02 OBJECTIVES

1. The objectives of stormwater drainage design are as follows:
 - (a) To ensure that inundation of private and public buildings located in flood-prone areas occurs only on rare occasions and that, in such events, surface flow routes convey floodwaters below the prescribed velocity/depth limits.
 - (b) To provide convenience and safety for pedestrians and traffic in frequent stormwater flows by controlling those flows within prescribed limits.
 - (c) Retain within each catchment as much incident rainfall and runoff as is possible and appropriate for the planned use and the characteristics of the catchment.
 - (d) To ensure the ecosystem integrity of Wollondilly's waterways is maintained and enhanced.
 - (e) To minimise ongoing maintenance requirements
 - (f) Utilise stormwater within development site to support healthier landscaped areas and canopy coverage through such uses as passive irrigation and stormwater harvesting
2. Development are required to consider both Volume and Peak Flows as part of an Integrated Stormwater Management approach. In some minor developments the adequate management of volume will be sufficient to also manage peak flow. In larger developments the management of Volume may not be sufficient to manage Peak Flow and some additional control measure will be needed. Modelling requirements are outlined in this section of the Specification.

***Integrated
Stormwater
Management***

3. In pursuit of these objectives, the following principles shall apply:

Design Principles

(a) New Developments are to provide a stormwater drainage system in accordance with the "major/minor" system concept set out in Australian Rainfall & Runoff (AR&R); that is, the "major" system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events.

(b) The design of the drainage system, and earthworks, for the development shall be such that the upstream drainage is not adversely affected and that the downstream drainage system is capable of carrying any increased discharges from the development. Such measures should include, but not be limited to, investigation of upgrading the existing downstream system and an investigation of providing stormwater retarding basins.

(c) The minor drainage system shall connect to a legal point of discharge acceptable to Council, such as public drainage systems (kerb and gutter), vegetated drainage lines or inter-allotment systems with easements. The major drainage system shall be designed to ensure adjoining downstream properties will not be adversely affected as a result of the development.

(d) Water Sensitive Urban Design (WSUD) principles and stormwater treatment shall be considered in the design of the drainage system for developments as outlined in Wollondilly Shire Council's Integrated Water Mnaagment Policy, Strategy and Water Sensitive Urban Design Guidelines. .

(e) Information provided by the NSW Government that indicates salinity may occur in parts of the Wollondilly Local Government Area (LGA). This salinity potential is due to inherent characteristics of the Wollondilly LGA landscape. As a result, buildings and other infrastructure in the Wollondilly LGA may be susceptible to salt damage.

Salinity

The applicant must thoroughly investigate the site to determine if there are any salinity issues to be addressed. The designer shall address salinity in their design. Steps taken may include, but are not limited to:

- Minimising depth of excavation/disturbance required for roadworks;
- Minimising infiltration of surface waters by providing adequate sub-soil drainage;
- Provision of adequate drainage for upstream catchments; and
- Use of appropriate materials in construction of roadworks.

Designers should also follow guidelines set out in Department of Infrastructure, Planning and natural Resources (2003) Guide: *Roads and Salinity* (ISBN: 0 73475377 2).

D5.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

Specifications as amended:

- | | | |
|------|---|-------------------------------------|
| C220 | - | Stormwater Drainage – General |
| C221 | - | Pipe Drainage |
| C222 | - | Precast Box Culverts |
| C223 | - | Drainage Structures |
| C224 | - | Open Drains including Kerb & Gutter |

Wollondilly Shire Council Water Sensitive Urban Design Guidelines November 2020
Western Sydney Street Design Guidelines September 2020

(b) Australian Standards

- AS 1254 - Unplasticised PVC (uPVC) pipes and fittings for stormwater or surface water applications.
- AS 2032 - Code of practice for installation of uPVC pipe systems.
- AS 3725 - Loads on buried concrete pipes.
- AS 4058 - Precast concrete pipes.
- AS 4139 - Fibre reinforced concrete pipes and fittings.

(c) State Authorities

- TfNSW - Model Analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings, 1979.
Department of Infrastructure, Planning and Natural Resources
Guide: Roads and Salinity (2003) (ISBN: 0 73475377 2)

(d) Other

- AUSTROADS - Bridge Design Code.
- Inst. of Eng. Aust - Australian Rainfall and Runoff – A guide to flood estimation. Aug 1987 and 2016.
- Queensland Urban Drainage Manual, Volumes 1 & 2, 1993.
- Sangster, WM., Wood, HW., Smerdon, ET., and Bossy, HG.
 - Pressure Changes at Storm Drain Junction, Engineering Series, Bulletin No. 41, Eng. Experiment Station, Univ. of Missouri 1958.
- Hare CM. - Magnitude of Hydraulic Losses at Junctions in Piped Drainage Systems. Transactions, Inst. of Eng. Aust., Feb. 1983.
- Concrete Pipe Association of Australia
 - Concrete Pipe Guide, charts for the selection of concrete pipes to suit varying conditions.
- Henderson, FM. Open Channel Flow, 1966.
- Chow, Ven Te - Open Channel Hydraulics, 1959.
- John Argue - Australian Road Research Board Special Report 34
 - Stormwater drainage design in small urban catchments: a handbook for Australian practice.
- Australian National Conference On Large Dams, Leederville WA.
 - ANCOLD 1986, Guidelines on Design Floods for Dams.
- Inst. of Eng. Aust - Australian Runoff Quality- a Guide to Water Sensitive Urban Design

HYDROLOGY

D5.04 DESIGN RAINFALL DATA

1. Rainfall patterns shall be adopted using the rainfall ensembles as outlined in the ARR 2019 procedures.
2. IFD rainfall data can be obtained from the Bureau of Meteorology web site and the ARR Data Hub web site.

***I-F-D
Relationships***

Files downloaded from these sites must be provide to Council when requesting a review of drainage and hydrological models.

3. Design Average Exceedance Probability (AEP) - For design under the "major/minor" concept, the design AEPs to be used are given below.
4. Exceedance intervals for minor events depends on the zoning of the land being serviced by the drainage system. The minor system design AEPs are detailed below:-

***Average
Exceedance
Probability***

- 5% for commercial/industrial area "minor" systems
- 10% for residential area "minor" systems
- 20% for rural residential and rural area "minor" systems
- 50% for parks and recreation area "minor" systems.
- 10% for residential property and interallotment drainage "minor" systems
- 5% for commercial/industrial property drainage "minor" systems
- 20% for on-site absorption trenches.

5. Where a development is designed in such a way that the major system flows involve surcharge across private property, then the underground system (both pipes and inlets) may need to be upsized to ensure flow across the property meets the standards outlined in section D5.29. A surcharge path shall be defined for systems even where 1% AEP flows can be maintained within the system. Easements and Restrictions as to use are to be provided in private property over pipe systems and surcharge paths.

D5.05 CATCHMENT AREA

1. The catchment area of any point is defined by the limits from where surface runoff will make its way, either by natural or constructed paths, to this point. Consideration shall be given to likely changes to individual catchment areas due to the full development of the catchment.
2. Where no detailed survey of the catchment is available, orthophoto maps, Council GIS data or LiDar are to be used to determine the catchments and to measure areas. Site survey should be undertaken to ensure accurate catchments and ensure piped drainage does not increase the catchment area greater than that calculated from the natural landforms.
3. Catchment area land use shall be based on current available zoning information and likely future zonings, where applicable. Percentage impervious for various land uses are given in table D5.1 and should be used where actual information is not available.

***Catchment
Definition***

Table D5.1

Development Type	Minimum Fraction Imperviousness
Passive Open Space	10%
Active Open Space	30%
Residential (Up to 699m ²)	75%
Residential (700 to 1499m ²)	60%
Residential (1500 to 4000m ²)	40%
Medium Density	80%
Commercial/Industrial	90%
Roads	90%

D5.06 REGIONAL FLOOD FREQUENCY ESTIMATION AND RATIONAL METHOD

1. Australian Rainfall and Runoff 2019 recommends the use of the Regional Flood Frequency Estimation (RFFE) technique to determine peak flows in small catchments. This method replaces the Probabilistic Rational Method defined in AR&R 1987. Use of the RFFE approach as setout in Book 3 of AR&R 2016 will be the preferred method to determine flowrates from urban catchments.

**Regional
Flood
Frequency
Estimation**

2. Calculations from Regional Flood Frequency Estimation Model software at <http://rffe.arr-software.org/> will be accepted by Council for the purpose of drainage design.

3. Use of the Rational Method, as defined in AR&R 1987 for determining flowrates from urban catchments may be acceptable for some calculations when the catchment is relatively small (approximately 10 ha) and the development is minor or the creation of complex models is not considered necessary. Prior approval to use this method must be obtained from Council's Infrastructure Planning Manager. The maximum time of concentration in an urban area shall be 15 minutes unless sufficient evidence is provided to justify a greater time. Surface roughness co-efficient "n" shall generally be derived from information in Chapter 14 of AR&R 1987. It should be noted that the use of IFD rainfall data from the Rainfall IFD data System 2016 should not be used in calculations using the 1987 Rational Method.

**Rational
Method**

4. Time of concentration should be determined for both pre and post development catchment using the same method, such as the Kinematic Wave Equation. Time of concentration should be used for the entire catchment, not lot catchments or partial catchments.

D5.07 HYDROLOGICAL MODELS

1. Hydrological models used should follow the requirements of AR&R , summaries of calculations are provided and details are given of all program input and output. A sample of a summary sheet for hydrological calculations is given in the Council publication SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN.

**Alternative
Models**

2. Where computer analysis programs are used, copies of the final data files and results of computer run shall be provided on submission of the design to Council and with the final drawings.

3. Where hydrological analysis is carried out using DRAINS/ILSAX. Loss data can be calculated from the Bureau of Meteorology data. As a minimum value, refer to the below table.

DRAINS/ILSAX

Parameter	Value
Impervious depression	1mm
Pervious depression	5mm
Soil Type	3
AMC	3

4. Where hydrologic modelling is carried out using RAFTS model, following parameter shall be used:

RAFTS

Initial Loss:		Continuing Loss :	
Impervious	1 mm	Impervious	0 mm/hr
Pervious	10 mm	Pervious	2.5 mm/hr

HYDRAULICS

D5.08 HYDRAULIC GRADE LINE

1. Hydraulic calculations shall generally be carried out in accordance with Australian Rainfall and Runoff and shall be undertaken by a qualified person experienced in hydrologic and hydraulic design. The calculations shall substantiate the hydraulic grade line adopted for design of the system and shown on the drawings. Summaries of calculations are added to the plan and details of all calculations are given including listings of all programme input and output. A sample of a summary sheet for hydraulic calculations is given in the Council's publication SUBMISSION REQUIREMENTS FOR ENGINEERING DESIGN.

Qualified Person

Calculations

2. The "major" system shall provide safe, well-defined overland flow paths for rare and extreme storm runoff events while the "minor" system shall be capable of carrying and controlling flows from frequent runoff events.

3. Downstream water surface level requirements are given below:-

Downstream Control

- (a) Known hydraulic grade line level from downstream calculations including pit losses at the starting pit in the design event.
- (b) Where the downstream starting point is a pit and the hydraulic grade line is unknown, a level equal to the surface level of the pit inlet in the downstream pit is to be adopted.

- (c) Where the outlet is an open channel and the design storm is the minor event the top of the outlet pipe shall be the downstream control.
- (d) Where the outlet is an open channel and the design storm is the major event, the downstream control shall be the greater of either the top of the outlet pipe or the 1% probability flood level.

4. The water surface in drainage pits during the minor system design storm shall be limited to 0.150m below the gutter invert for inlet pits and 0.150m below the underside of the lid for junction pits.

Water Surface Limits

5. Where the hydraulic calculations are performed by the use of computer model, electronic files of computer input data and results shall be provided to the Principal Certifying Authority for checking.

6. Where the hydraulic calculations are carried out by running computer models such as DRAINS, HECRAS, SWMM, MOUSE etc. the results from these model shall be calibrated against measured flows, depth etc. If the calibration of the model is not possible due to lack of data, outputs from the model shall be checked against output from a rational/manual method of calculation or the output from another model. Acceptance of the model output shall be the consideration of the relevant approval authority.

D5.09 MINOR SYSTEM CRITERIA FOR STREET AND TRUNK DRAINAGE

1. The acceptable gutter flow width for roads with a carriageway width of 8m or more shall be a maximum 2.5m for a minor system. For carriageway widths less than 8m the gutter flow width shall be a maximum 1.5m for a minor system. Gutter flow widths shall be reduced to ensure gutter flows do not overtop the kerb or do not have a Velocity Depth Product of greater than 0.4m²/s. Gutter flow widths shall not exceed 0.5m at pedestrian kerb ramps for marked pedestrian crossings, school crossings, bus stops or other areas of usually high pedestrian traffic

Gutter Flow Widths

In streets with a low level footpath the maximum flow depth shall be 75mm. Table drains should be sized to ensure table drain flows do not extend beyond the road shoulder.

2. Gutter and table drain flows greater than 20 l/s will not be permitted to flow across an intersection. It will be necessary to intercept these flows with a kerb inlet pit or culvert.

3. Minimum conduit sizes are given below:

- The minimum pipe size shall be 375mm diameter.
- The minimum box culvert size shall be 600mm wide x 300mm high.

Conduit Sizes

4. Minimum and maximum velocity of flow in stormwater pipelines shall be 0.6m/sec and 6m/sec respectively.

Velocity Limits

5. The minimum pipe grade shall generally be 0.5%. Pipe grades less than 0.5% may be considered for pipes larger than 900 mm dia. Pipes with a grade greater than 20% will require anchor blocks at the top and bottom and at intervals not exceeding 3.0m.

Pipe Grades

6. The target grade for kerb and gutters should be 1%, unless for sag points, crests or kerb returns.

Gutter Grades

D5.10 PITS

1. Inlet Pits shall be spaced so that the gutter flow width is limited in accordance with this specification and so that the inlet efficiency is not affected by adjacent inlet openings. Preference shall be given to the location of drainage pits near the centre of lots or with lintels central on lot boundaries. Pits located on small radius curves (less than 20m radius) shall be avoided. Location of inlet pits on kerb returns in line with normal pedestrian flow is to be avoided. **The designer shall ensure that the kerb inlet pits are located clear of the tangent points on kerb returns.**

Spacing

2. Other pits shall be provided
 - To enable access for maintenance.
 - At changes in direction, grade, level or class of pipe.
 - At junctions.
3. The maximum recommended spacing of pits where flow widths are not critical is:

Pipe Size (mm)	Spacing (m)
Less than 1200	75
1200 or larger	100

Table D5.1 Pit Spacing

4. Maximum kerb inlet lengths to side entry pits are to be a preferred maximum of 1.8m for on grade pits or 2.4m for sag pits, with an absolute maximum of 3.0m where the grade is 10% or more. The designer shall minimise use of any lintel longer than 2.4m. The absolute minimum kerb inlet pit lintel shall be 1.2m, that shall only be used where a change of pipe grade or alignment is the main reason for the pit.

Kerb Inlet Pit sizes

5. Inlet pits must be sufficiently large to permit the design inflow. Information on pit capacities is available in the following sources:-

Inlet Capacity

- Transport for New South Wales "Model analysis to determine Hydraulic Capacities of Kerb Inlets and Gully Pit Gratings", with due allowance to inlet bypass due to grade, for on-grade pits, and recognised orifice or weir formulae for sag inlet pits.
- Pit relationships given in AR&R.

6. None of these pit charts include any blockage factors. The percentage of theoretical capacity allowed in relation to type of pit is given below:-

Allowance for Inlet Blockage

Condition	Inlet Type	Percentage of Theoretical Capacity Allowed
Sag	Side entry	80%
Sag	Grated	50%
Sag	Combination	Side inlet capacity only Grate assumed completely blocked
Sag	"Letterbox"	50%
Continuous Grade	Side entry	80%
Continuous Grade	Grated	50%
Continuous Grade	Combination	90%
-	Headwalls*	50%

Table D5.2

* Headwalls without appropriate screen protection.

7. All pits shall be sized in accordance with table D5.3 to allow access for maintenance purposes.

Table D5.3 *Pits less than 600 x 600 shall only be used for private yard drainage or minor drainage lines. They are not to be used in interallotment or common space drainage lines or under driveways or other paved common areas.

Pit Depth (mm)	Maximum Pit Size (mm)	Minimum Thickness (mm)	Private	Road	Precast	Insitu	Insitu Reinforcement Requirements
<1200	900 x 900	150	Y	-	Y	Y	No reinforcement required
1200 - 1500	1200 x 1200	150	Y	Y	Y	Y	SL82 mesh at min 40 cover to inside face of walls and base
1500 - 1800	1200 x 1200	150	-	Y	-	Y	SL92 mesh at min 40 cover to inside face of walls and base
1800 - 3000	1500 x 1500	150	-	Y	-	Y	N12 @ 250 C/C Each Way at min 40 cover to inside face of walls and base
>3000	>2000		-	Y	-	Y	Structural Design Required

- 8. Concrete to have a minimum compressive strength (F'c) of 25 Mpa at 28 days. **Minimum Strength**
- 9. Top of benching to be 1/2 of outlet pipe diameter. **Benching**
- 10. Provide 3m of 100 mm diameter subsoil drainage pipe wrapped in fabric sock adjacent to inlet pipe inverts and draining to the pit. **Subsoil**
- 11. Bypass flow at a pit shall not exceed 20% of the approach flow for the critical design rainfall. **Bypass Flow**
- 12. All pits to be provided with locking clips. **Locking Clips**
- 13. All grates to be hot dipped galvanised. **Galvanised Grates**
- 14. Step irons to be provided to all pits greater than 1.2m depth (from grate to invert). Refer drawing WSC.D5.3. **Step Irons**
- 15. V-Drains must not be used unless specified and approved by council. **V-Drains**
- 16. For pits greater than the required maximum area and/or have a non-rectangular shape, structural design is required. **Non-Rectangular Pits**
- 17. Pits deeper than 600mm shall have a minimum 600mm x 600mm opening. **Minimum Opening**
- 18. For pits which will have pipes greater than 525mm, 2N16 trimmer bars are required around the edges of the pipe. **Trimmer Bars**
- 19. For pits 1200 and greater in depth, lap N12 L Bars @ 400 C/C for base to wall connection.
- 20. Pits in areas of salinity hazards shall be appropriately designed. **Salinity**

D5.11 HYDRAULIC LOSSES

1. Losses at junction pits, slope junctions, bends, transition structures, end pits and outlets shall be considered. Reasonable pressure change co-efficients are to be selected using Missouri Charts, Hare Charts and U.S corp of Engineers mitre bend charts.

Pit Losses

2. Allowable reduction in "K_U" due to benching is given in Missouri Charts.

3. Computer program default pressure change co-efficient "K_U" shall not be acceptable unless they are consistent with above charts. The chart used and relevant co-efficients for determining pit "K" values from that chart shall be noted on the hydraulic summary sheet provided for plan checking and included on the final design drawings.

4. Bends may be permissible in certain circumstances and discussions with Council regarding their use is required prior to detailed design.

Bend Losses

5. Requirements for private pipes entering Council's system are in section D5.27

6. Construction of a junction without a structure should be avoided where possible. Permission to do this is required by Council prior to detailed design.

Pipe Junction Losses

7. Going from larger upstream to smaller downstream conduits is not permitted without approval of Council prior to detailed design. In going from smaller to larger pipes benching shall be provided in pits to enable a smooth flow transition.

Contraction/Expansion Losses

8. Drainage pipe systems shall be designed as an overall system incorporating pipe and all other losses, with due regard to the upstream and downstream system and not as individual pipe lengths. Drainage pipeline systems shall generally be designed as gravity systems flowing full at design discharge, but may be pressurised with the use of appropriate pits and joints only with Council approval. Pipe friction losses and pipe sizes in relation to discharge shall be determined using the Colebrook-White formula with the acceptable roughness co-efficient being 0.6mm for concrete pipes, 0.3mm for FRC and polyethylene and 0.03 for uPVC pipes.

Pipe Friction Losses

D5.12 MAJOR SYSTEM CRITERIA

1 All drainage designs shall incorporate an assessment of major system flows. The major system provides a safe and adequate "escape route" for stormwater from rare and extreme storm events.

2 The design standard for the major system is the 1% AEP event. Consideration should be given to the potential impacts of rarer storms events. Analysis of the impact of the Probable Maximum Flood (PMF) is required in instances where the quantity of stormwater is such that catastrophic failure of the proposed system/structures may place life and limb at risk.

3 The system shall be designed to ensure drainage from upstream entering the subdivision is not obstructed or adversely affected such that flow depths on adjoining properties will be increased.

4 Roads, pathways, open space reserves and drainage reserves will generally form the flow path by which the major system flows are safely routed through a new subdivision. Using private properties as part of the major flow path should be avoided where possible. Where the major flow path is through a private property, the requirements outlined in section D5.29 shall apply.

5 Reverse crossfall shall be used where the overland flow path crosses the footway.

6 Surcharging of drainage systems which would provide for water depth above the top of kerb will not be permitted except as defined below. Surcharging of drainage system

Surcharging

for storm frequencies greater than the design minor storm event may be permitted across the road centreline where the road pavement is below the natural surface of the adjoining private property. Flow across footpaths will only be permitted in situations specifically approved by Council.

7. The velocity x depth product of flow across the footpath and within the road reserve shall be such that safety of children and vehicles is considered. The maximum allowable depth of water is 0.2 metres and the maximum velocity x depth product of $0.4\text{m}^2/\text{s}$ is permitted. Where the safety of only vehicles can be affected, a maximum velocity x depth product of $0.6\text{m}^2/\text{s}$ is permitted. In open channels and flow paths through public and drainage reserves the above velocity x depth product criteria will be followed where possible or the design shall address the requirements for safety in relation to children by providing safe egress points from the channel or other appropriate methods.

**Velocity/
Depth Criteria**

8. Freeboard requirements for floor levels and levee bank levels from flood levels in open channels, roadways and stormwater surcharge paths are given below:

Freeboard

Generally:-

- (a) A minimum freeboard of 0.5m shall be provided between the 1% AEP flood level and floor levels on structures and entrances to underground car parks. A higher freeboard may be required in certain circumstances.
- (b) Where the road is in fill or overtopping of kerbs and flow through properties may occur a 100mm freeboard shall be provided between the ponding level of water in the road and the high point in the footpath. Driveway construction in these instances needs to consider this requirement.

In Surcharge Paths:-

- (c) A minimum freeboard of 0.5m shall be provided between the 1% AEP flood level and floor levels on structures and entrances to underground car parks.

In Open Channels:-

- (d) A minimum freeboard of 0.5m shall be provided between the 1% AEP flood level and floor levels on structures and entrances to underground car parks.

9. Flow capacities of roads should be calculated using AR&R 2019.

**Roadway
Capacities**

10. The major drainage system shall be designed to ensure adjoining downstream properties will not be adversely affected as a result of the development. Where it is proposed to divert, re-direct or intensify the flow of stormwater into adjoining property, a "permit to discharge stormwater" shall be sought and submitted to Council prior to the approval of Engineering design plans. The above shall apply unless otherwise specified by Council. A permit shall also be sought to carry out construction work on adjoining property and such permit also presented to Council.

11. The depth of flow in road kerb and gutter in major storm event shall not be more than 200 mm.

12. Major drainage systems managed by Council must not be directed through private lots unless with prior approval from Council. Approval will only be given where appropriate drainage easements benefit Wollondilly Shire Council. Piped road drainage through private land must contain the 1% AEP flow with no calculated overland flow. Major drainage systems must not be directed to private detention basins. Road drainage cannot be controlled through private basins or on private land.

**Road Drainage
Through
Private Land**

D5.13 OPEN CHANNELS

1. Generally, open channels will only be permitted where they form part of the trunk drainage system and shall be designed to have smooth transitions with adequate access provisions for maintenance and cleaning. Where Council permits the use of an open channel to convey flows from a development site to the receiving water body, such a channel shall comply with the requirements of this Specification.

Safety

2. Design of open channels shall be generally in accordance with AR&R, and shall be designed with safety requirements as set out in AR&R as a primary criterion. Open channels will be designed to contain the major system flow less any flow that is contained in the minor system, with an appropriate allowance for blockage of the minor system.

3. Friction losses in open channels shall be determined using Mannings "n" values given below:

**Channel
Roughness**

Mannings "n" Roughness Co-efficients for open channels shall generally be derived from information given below:

Concrete Pipes or Box Sections	0.011
Concrete (trowel finish)	0.014
Concrete (formed without finishing)	0.016
Sprayed Concrete (gunite)	0.018
Bitumen Seal	0.018
Bricks or pavers	0.015
Pitchers or dressed stone on mortar	0.016
Rubble Masonry or Random stone in mortar	0.028
Rock Lining or Rip-Rap	0.028
Corrugated Metal	0.027
Earth (clear)	0.022
Earth (with weeds and gravel)	0.028
Rock Cut	0.038
Short Grass	0.033
Long Grass	0.043
UPVC	0.010
High Density Polyethylene	0.008

4. Where the product of average Velocity and maximum flow Depth for the design flow rate is greater than 0.4m²/s, the design will be required to specifically provide for the safety of persons who may enter the channel. The depth of flow in the channel should not exceed 1.2m for the 1% AEP flow.

5. Maximum side slopes on grassed lined open channels shall be 1 in 4, with a preference given to 1 in 6 side slopes, channel inverts shall generally have minimum cross slopes of 1 in 20.

Side Slopes

6. The channel shall be designed to ensure subcritical flows with the Froude Number no greater than 0.8. Measures may have to be incorporated to reduce the bed slope, such as introducing drop structures

7. Low flow provisions in open channels (man-made or altered channels) will require low flows to be contained within a pipe system or concrete lined channel section at the invert of the main channel. Subsurface drainage shall be provided in grass lined channels to prevent waterlogging of the channel bed. The width of the concrete lined channel section shall be the width of the drain invert or at least sufficiently wide enough to accommodate the full width of a tractor.

Low Flows

8. Transition in channel slopes to be designed to avoid or accommodate any hydraulic jumps due to the nature of the transition.

**Hydraulic
Jumps**

9. Appropriate measures must be taken to protect the channel from scour. In grassed lined channels the maximum flow velocity is to be 2.5m/s. Adequate scour protection and/or energy dissipaters shall be designed at all inlets to the channel, at the channel outlet and at any point in the channel where there is a significant change in flow conditions.

10. Turfing and landscaping of channels and basins should take account of possible changes to the water table and salt content. This may affect the type and species of planting; accordingly, the designer may need to seek specialist advice as part of the landscape and rehabilitation design process.

8. A watercourse shall be defined ‘a river, creek or other natural watercourse (whether modified or not) in which water is contained or flows (whether permanently or from time to time).’

Definition of Watercourse

9. Engineered ‘Natural’ channels shall be designed with a meandering plan form, a main channel with a floodplain, a series of pools and riffle zones (rapids) and riparian and floodplain vegetation.

Engineered Watercourse

10. Watercourses, open channels and defined overland flow paths have significant environmental and stormwater management value to the community. Changes to the condition of a watercourse such as realigning or piping can reduce it’s overall value as a stormwater drainage asset. Activities within or adjacent to a watercourse may require the approval of a State or Federal Government Authority. Generally, piping of a watercourse, open channel or defined overland flow path will NOT be approved, other than road culverts, unless it can be demonstrated to the Manager Infrastructure Planning that there is no significant loss of environmental value or increase in flood risk to the community. The Manager Infrastructure Planning will assess any application to pipe a watercourse with consideration to the following:

Piping of Watercourses and Overland Flow Paths

- It must have minimal impact on the health of riparian vegetation and water quality in the system.
- Must not result in cross catchment flows.
- Should result in a significant community benefit.
- Does it reduce existing flooding issues or reduce flooding risk.
- Must not have adverse effects on flooding or flooding risk on adjacent properties(i.e. flood extent or risk must not be increased upstream or downstream)
- Has the proposal considered catchment characteristics, potential debris loading and the effect of inlet and pipe blockages on overland flows.
- Is it of a low maintenance design.
- Overland flows from major storm events, and with consideration of pipe blockage does not exceed the requirements as setout in section D5.30 Building on Flood Effected Land.
- The proposed works has undergone an extensive risk assessment to determine the impact on the development and adjoining properties in the event of 100% blockage of inlet structures during all storm events upto the PMF.

D5.14 MAJOR STRUCTURES

1. All major structures shall be designed for the 1% AEP storm event without afflux in urban areas. Some afflux and upstream inundation may be permitted in certain rural and urban areas provided the increased upstream flooding is minimal and does not inundate private property. **Afflux**

2. A minimum clearance of 0.5m between the required AEP flood level and the underside of any major structure superstructure is required to allow for passage of debris without blockage. This freeboard may need to be increased for bridges in accordance within the following table. **Freeboard**

(i) Large Box Culverts and Deck used as road surface	0.5 m.
(ii) Slab, Beam, Concrete Girder or Concrete Frame Bridges across streams where the maximum velocity is less than 3 m/s (with or without debris)	0.5m
(iii) Slab, Beam, Concrete Girder or Concrete Frame Bridges across streams where the maximum velocity is greater than 3 m/s.	1.0m
(iv) Plate Girder, Timber or Steel Truss Bridges across streams where the maximum velocity is less than 3 m/s.	1.0m
(v) Plate Girder, Timber or Steel Truss Bridges across streams where the maximum velocity is greater than 3 m/s.	1.25m

3. All bridges shall be designed for the relevant TfNSW/AUSTROADS flood intensity without afflux in urban areas. The effects of the PMF shall be investigated and alterations made to the design to suit. **Bridges**

4. Certified structural design shall be required on bridges and other major culvert structures and may be required on some specialised structures. Structural design shall be carried out in accordance with AUSTROADS Bridge Design Code.

5. All culverts shall be designed for 1% probability flood intensity without afflux in urban areas. **Culverts**

6. Culverts (either pipe or box section) shall be designed with due regard being given to inlet and exit losses, inlet and outlet control and scour protection. Recommended design procedures are contained in Section 3 *Hydraulics of Precast Concrete Conduits* - Hydraulic Design Manual - by Concrete Pipe Association of Australia.

7. Where culverts are used for road crossings the following design criteria shall apply:

- (i) Roads and embankments shall have a minimum freeboard of 500mm above the 1% AEP top water level.
- (ii) Headwalls, surface inlet pits and surcharge pits shall incorporate scour protection on the upstream and downstream ends of the culvert. Scour protection measures are to be appropriate for design conditions.
- (iii) A causeway shall be provided over the culvert for extremely large flood events or for improper functioning of the culverts.
- (iv) Base slabs for box culverts shall be cast-in-situ and designed by a certified practicing structural engineer.

D5.15 RETARDING STRUCTURES

1. For each AEP, a range of storm events shall be run to determine the peak flood level and discharge from the retarding basin. Storm patterns shall be those given in ARR 2019. Sensitivity to storm pattern should be checked by reversing these storm patterns.

Critical Storm Duration

2. The critical storm duration with the retarding basin is likely to be longer than without the basin. A graph showing the range of peak flood levels in the basin and peak discharges from the basin shall be provided for the storms examined.

3. Flood Routing should be modelled by methods outlined in ARR 2019.

Routing

4. The high level outlet to any retarding basin shall have capacity to contain a minimum of the 1% AEP flood event. Additional spillway capacity may be required due to the hazard category of the structure. The hazard category should be determined by reference to the Australian National Committee on Large Dams Incorporated (ANCOLD) rating system.

High Level Outlet

5. The spillway design shall generally be in accordance with the requirements for Open Channel Design in this Specification.

6. Pipe systems shall contain the minor flow through the Retarding Basin wall. Outlet pipes shall be rubber ring jointed with lifting holes securely sealed. Pipe and culvert bedding shall be specified to minimise its permeability, and cut off walls and seepage collars installed where appropriate.

Low Flow Provision

7. The low flow pipe intake shall be protected to prevent blockages.

8. Minimum floor levels of dwelling shall be 0.5m above the 1% AEP flood level in the basin.

Freeboard at Dwellings

9. Where a retention basin receives inflow from a public road or public land, the retention basin is to be wholly constructed on public land and designed to ensure no ponding of water on private lots. In a community title development, where a retention basin receives inflow from community land, the retention basin is to be wholly constructed on community land. Detention basins on private lots should not receive inflow from any other lot. Where this arrangement is impractical, private lots containing a retention basin that accepts inflow from other private properties must be burdened by an easement over the detention basin benefiting all lots draining to that basin. Any private lot with a retention/detention basin is to have a public positive covenant created on the title requiring that the property owner maintain the basin in good working order.

10. All exposed areas are to be vegetated to minimise scouring of batters.

Vegetation

11. Public Safety Issues – Basin design is to consider the following aspects relating to public safety.

Safety Issues

- The degree of risk is typically dependant on the grades of the land adjacent to the edge of the water and progressing into deeper water. Childproof fences will generally be required around dams and other water bodies in urban areas where the following criteria cannot be satisfied:

Approach Grade to Maximum Depth	Maximum Depth (m)
Greater than 1:4	0.3
1:4 to 1:15	0.8
Less than 1:15	No Maximum

Notwithstanding the above, Council may require safety fences around water bodies where, due to the nature of the landuse in the proximity of the waterbody, it is considered that there is an unacceptable risk.

- Side slopes are to be a maximum of 1 in 6 to allow easy egress. Side slopes of greater than 1 in 4 may require handrails to assist in egress.
- Water depths shall be, where possible, less than 1.5m in the 1% AEP storm event. Where neither practical nor economic greater depths may be acceptable. In that case the provision of safety refuge mounds should be considered.
- Depth indicators should be provided indicating maximum depth in the basin.
- Protection of the low flow intake pipe shall be undertaken to reduce hazards for people trapped in the basin.
- Signage of the spillway is necessary to indicate the additional hazard.
- Basins shall be designed so that no ponding of water occurs on to private property or roads.
- No planting of trees in basin walls is allowed.
- No basin spillway is to be located directly upstream of urban areas.
- Submission of design plans to the Dam Safety Committee is required where any of these guidelines are not met or Council specifically requires such submission.

12 Basin design is to also consider the following:

Other Issues

- The minimum slope of the basin floor in a dry basin is 1%.
- Outlets are to have scour and debris control along with safety rails where applicable.
- Low flows through the detention basin shall be by means of a low flow pipeline or concrete dish or other system acceptable to Council. Where basins are integrated into open space activities such as playing fields, a low flow pipeline shall be provided. The low flow structure shall cater for two thirds of the 1 year flow, unless noted otherwise.
- Basins shall be structurally designed as small dams. A typical section through the embankment wall is to be shown on engineering plans, and include a clay core or cut-off wall.

STORMWATER DETENTION

D5.16 STORMWATER DETENTION

1. Equal consideration must be given to the impacts of increased volume of stormwater runoff.

Re-development

Installation of Stormwater Detention is required on redevelopment sites within the Shire where under capacity drainage systems exist. A redevelopment site is defined as a site which used to have or was originally zoned to have a lower density development than is proposed.

2. Onsite Stormwater Detention (OSD) systems shall be acceptable in situations where there is an existing stormwater pipe system that is unable to cater for the increase in discharge due to the development, when the development will involve an increase in impervious area on the site and where it is intended to connect stormwater directly to the road kerb and gutter only and the discharge for the 10% AEP storm exceeds 25 litres per second.

3. It is also required to provide OSD to limit the post development discharge from a development site into a natural water course in order to mimic the pre-development condition up to rainfall event of 50% AEP.

4. Computation for on-site detention systems shall use a recognised computer model and include the 100%, 50%, 20%, 10%, 5%, 2%, and 1% AEP storms for all durations. The discharge (both piped and overland) from the post- developed site is not to exceed the rate of runoff from the pre-developed site for all storms.

5. Determination of storage size shall be based on 1% AEP storm. Unless shown otherwise, calculation for a system including permanent storage for re-use, shall assume the permanent storage is full.

Storage

6. Where driveways and carparking areas form part of detention volume, depths of ponding in such areas shall not be greater than 200 mm to avoid damage to vehicles.

7. Where underground tanks are proposed for detention of stormwater, the tanks shall be designed by a suitably qualified structural engineer. Provision shall be made for maintenance of the tank by allowing easy access, specifying the maintenance schedule and also by dealing with any health and safety risks involved. Consideration shall be given to re-use of the stored water for use in landscaping, toilet, laundries etc.

8. The orifice plate is to be minimum 200mm x 200mm flat stainless steel plate 3mm thick. Orifice diameter shall not be less than 25 mm.

Orifice Plate

9. A minimum of 500 mm freeboard to habitable floors above the 1% AEP ponding water level is to be provided.

10. The location of the Stormwater Detention System shall be shown on the Deposited Plan or included as a site plan attached to the Section 88B Instrument.

11. Prior to the issue of the Occupation Certificate or occupation of the site, the creation of a Restriction on Use of Land and Positive Covenant over the operation and maintenance of the On-Site Detention System are to be registered with the Land Titles Office. Wollondilly Shire Council shall be nominated as the body empowered with authority to release, modify or vary the restrictions.

12. On completion of construction, the works are to be certified by a suitably qualified and experienced civil engineer in conjunction with Works-AS- Executed Plans.

**Works
Certification**

13. Where a subdivision development proposes on lot detention as part of overall Stormwater Management for the development, calculations shall be provided showing a Permissible Site Discharge (PSD) and Site Storage Requirement (SSR) for each lot. Calculations shall be based on a standard dwelling and impervious surface expected for the lot sizes. SSR for each lot shall be limited to 4KL for Residential Small Lots (450-699m²) and 7KL for Standard Residential lots (700-1499m²). A Restriction on the use of land shall be registered on the Certificate of Title for each burdened lot(s) that specifies the calculated Permissible Site Discharge (PSD) and Site Storage Requirement (SSR).

**PSD and SSR
Calculations**

14. Public drainage or overland flows shall not be managed or directed to a private detention basin. Road drainage should not be directed through a private lot unless absolutely necessary. Where it is unavoidable, drainage shall cater for the 1% AEP storm event with no design overland flow.

**Public vs
Private
Drainage**

INTERALLOTMENT DRAINAGE

D5.17 INTERALLOTMENT DRAINAGE

1. Interallotment Drainage shall be provided for every allotment which does not drain directly to its street frontage or a natural watercourse. Interallotment drainage will generally not be necessary for rural subdivisions with a lot size greater than 5000m².

2. The maximum number of lots draining to a single interallotment drainage line shall be ten (10). More than 10 lots will require prior approval by Council. Preference shall be given to increasing the number of connections to street drainage as a means of reducing the number of lots serviced by each interallotment drainage line.

Maximum lots

3. The minimum drainage easement width for interallotment drainage systems to be taken in favour of the upstream allotments shall be as shown below. easements shall be created with Council as the Authority empowered to vary, modify or release.

Easement widths

Pipe Diameter	Minimum Easement Width
150 – 300mm	1.5m
Greater than 300mm	3.0m

4. The interallotment drain shall be designed to accept concentrated drainage from buildings and paved areas on each allotment for flow rates having a design AEP the same as the "minor" street drainage system.

Pipe Capacity

45. In lieu of more detailed analysis, refer to Table D5.1 for assumed impervious fractions of surface areas contributing runoff to the interallotment drain:-

Impervious Area

6. Pipes shall be designed to flow full at design discharge without surcharging of pits.

7. Interallotment drainage pits shall be located at all changes of direction and/or grade. Interallotment drainage pits shall be provided in each lot. A 150mm diameter pipe stub shall be provided in each interallotment pit that is provided for future connection of lot drainage. Pits shall be constructed of concrete, with minimum 100mm thick (if precast) or 150mm (if cast in situ) walls and floor and have minimum internal dimensions as shown in table D5.3. Notwithstanding the requirements of table D5.3, all pits in interallotment drainage lines shall be a minimum 600 x 600 mm internal dimensions. Pits shall have a precast heavy duty 'footpath grade' concrete lid and surround from an approved manufacturer finished flush with the surface of works. Depressed heavy duty 'footpath grade' grated inlets are acceptable.

Pits

8. Interallotment drainage shall have a minimum longitudinal gradient of 1%. Grades less than 1% but greater than 0.5% may be accepted for minor interallotment drainage lines on the condition that the drainage meets all other design standards and it is approved by Council's Development Engineer.

Minimum Pipe Grade

9. Each lot must have an interallotment pit located on the drainage line fitted with a stub connection for future development.

- | | |
|--|---------------------------------------|
| <p>10. Interallotment drainage shall be constructed from rubber ring jointed pipes of either fibre reinforced concrete drainage pipe, reinforced concrete pipe, polyethylene or UPVC pipe which shall conform respectively to the requirements of AS 4139, AS 4058, AS 2566 and AS 1254. In public road and recreation reserves where vehicle loads may be encountered, reinforced or fibre reinforced concrete pipes min.class 3 or polyethylene pipes only, shall be used. The minimum pipe diameter in public areas shall be 375mm.</p> | <p>Pipe Type and Standards</p> |
| <p>11. Where interallotment drainage and sewer mains are laid adjacent to each other they are to be spaced minimum 1.5 metres between pipe centrelines (where the pipe inverts are approximately equal).</p> | <p>Sewer Main Interaction</p> |
| <p>12. Where there is a disparity in level between inverts the spacing is to be submitted for approval.</p> | |
| <p>13. Where sewer mains are in close proximity to interallotment drainage lines they are to be shown on the interallotment drainage plan.</p> | |
| <p>14. Where the flow in the interallotment drainage line exceeds 25 l/s during the design "minor" storm event, direct discharge to the kerb and gutter will not be permitted. The interallotment system will need to connect to Council's piped drainage system or to a suitable natural watercourse. See section 5.27 for details on disposal of property drainage.</p> | |
| <p>15. For any additional information not defined in this specification, refer to AS3500.3.</p> | |

DETAILED DESIGN

D5.18 CONDUITS

- | | |
|---|--|
| <p>1. Conduits and materials shall be reinforced concrete or fibre reinforced concrete. Polyethylene pipelines may be acceptable for use in roads other than state or regional roads or along commercial/industrial roads. PVC pipes will not be accepted as a Council pipeline. Pipes shall conform with the test requirements of the relevant Australian Standard.</p> | <p>Conduit and Material Standards</p> |
| <p>2. Pipe Bedding and Cover for reinforced and fibre reinforced concrete pipes shall be determined from the Concrete Pipe Association "Concrete Pipe Guide" or AS 3725. For uPVC pipes, requirements shall be to AS 2032.</p> | <p>Bedding and Cover</p> |
| <p>3. All concrete pipes shall have rubber ring joints.</p> | <p>Conduit Jointing</p> |
| <p>4. Drainage lines in road reserves shall generally be located under and parallel to the kerb (for detailed alignment requirements see Council SD54d – standard grated KIP). All reasonable measures should be taken to limit the extent of piping beneath the road pavement. Drainage lines in easements shall generally be centrally located within the easement.</p> | <p>Conduit Location</p> |

D5.19 PIT DESIGN

1. Pits shall be designed with benching to improve hydraulic efficiency and prevent water ponding. Safety and safe access are important considerations in pit design.

D5.20 STORMWATER DISCHARGE

- | | |
|---|---------------------|
| <p>1. A suitable headwall shall be constructed at culvert or pipe system outlets to protect against scour unless outlet conditions dictate the use of more substantial energy dissipation arrangements.</p> | <p>Scour</p> |
|---|---------------------|

2. At points of discharge of gutters or stormwater drainage lines or at any concentration of stormwater from one lot on to adjoining properties, either upstream or downstream, Council will require the subdivider to enter into a Deed of Agreement with the adjoining owner(s) granting permission to the discharge of stormwater drainage and the creation of any necessary easements with the cost of the easement being met by the developer.

Easements

3. Where the drainage is to discharge to an area under the control of another statutory authority eg, Public Works, the design requirements of that Statutory Authority are also to be met.

4. The minimum drainage easement width for drainage systems to be taken over by Council shall be as shown below:

Council Control

Max. Nominal Pipe Diameter (mm)	Minimum Easement width (m)**
Up to 900	3.0
1200	3.5
1500	4.0
1800	4.5
Over 1800 and box culverts	As required by Council

** The overall width of the easement in Council's favour shall be such as to contain the full width of overland flow, or open channel flow in the major system design event, and any access track if required by Council.

5. Discharge to Recreation Reserves – Piped stormwater drainage discharging to recreation reserves or other Council land is to be taken to a natural water course and discharged in an approved outlet structure or alternatively taken to the nearest trunk stormwater line. Drainage lines proposed to cross either existing or proposed non-operational Council land will require specific prior Council consent in writing and, if approved, a drainage easement in Council's favour at the applicant's expense. The applicant should liaise with Council's Property Department at design stage.

Council Consent

D5.21 MISCELLANEOUS

1. Subsoil Drainage shall be provided in pipe trenches as outlined below.

Subsoil Trenches

2. In cases where pipe trenches are backfilled with sand or other pervious material, a 3m length of subsoil drain shall be laid in the bottom of the trench immediately upstream from each pit or headwall. The subsoil drain shall consist of 100mm diameter corrugated PVC ag. pipe in TfNSW approved geotechnical stocking.

Subsoil Drain at Pits

3. The upstream end of the subsoil drain shall be suitably capped and the downstream end shall discharge through the wall of the pit or headwall, and finished flush with the inside wall.

4. Termination of Kerb and Gutter and Associated Scour Protection - Kerb and Gutter shall be extended to drainage pit or natural point of outlet. Where outlet velocity is greater than 2.5m per second or where the kerb and gutter discharge may cause scour, protection shall be provided to prevent scour and dissipate the flow.

Kerb & Gutter Termination

DOCUMENTATION

D5.22 PLANS – See DSQ

D5.23 EASEMENTS AND AGREEMENTS – See DSQ

D5.24 SUMMARY SHEETS - See DSQ

D5.25 COMPUTER PROGRAM FILES AND PROGRAM OUTPUT - See DSQ

PROPERTY DRAINAGE

D5.26 PROPERTY DRAINAGE SYSTEMS

1. Property drainage systems should have:

- Suitable sub-surface drainage to protect structures and mitigate long term surface water ponding, ***Sub-Surface***
- A system for collecting and conveying stormwater runoff that will prevent water entering buildings or damaging improvements on the site, minimise nuisance for people accessing buildings, prevent long term surface water ponding, prevent erosion and protect adjoining and downstream properties from any adverse stormwater impacts resulting from improvements on the property, ***Piped (Minor) System***
- A system of overland flow paths to provide fail-safe protection of buildings on the property and protection to adjoining downstream properties in the event of pipe blockage or storm events that generate greater runoff than the pipe capacity. ***Paths for Overland Flow***

2. Runoff from all new impervious surfaces (roofs and paving) on the property from storms up to the design storm listed in section D5.04 must be collected and piped to a suitable point of discharge as outlined in section D5.28.

3. Runoff from grassed and landscaped areas need only be collected and piped to Council's system where:

- regrading or other improvements will concentrate runoff or increase the rate of flow onto adjoining properties or across a public footway, or
- long term ponding will occur that could constitute a health hazard or a significant nuisance for property users. ***Runoff from Grassed Areas***

4. Runoff currently entering the site from upstream properties should not be obstructed from flowing onto the site and should not be redirected so as to increase the quantity or concentration of surface runoff entering adjoining properties. Where the overland flow rates are large, the requirements outlined in section D5.29 will need to be satisfied. ***Water from upstream lots***

5. Where the efficiency of any existing drainage system on the property will be compromised by proposed additional site improvements, the existing system is to be suitably modified to offset any adverse impacts. ***Existing Property Improvements***

Pipes

6. The minimum pipe size for property drainage shall be 90mm Ø where the line receives only roofwater runoff, or 100mm Ø in all other cases.

Min. Pipe Sizes

7. The minimum pipe grade shall be 1% for pipes less than or equal to 225mm Ø and 0.5% for large pipes.

Min. Pipe Gradients

8. The minimum pipe cover within private property shall be as follows:

Not subject to vehicle loadings	100mm In Residential Property 300mm Other than Residential Property
May be subject to vehicle loading	450mm
Under Driveways - Heavy Vehicles	100mm thick granular overlay then at least 150mm of reinforced concrete
- Light Vehicles	100mm thick granular overlay then at least 100mm of concrete

Pits

9. Stormwater pits or cleaning eyes shall be installed to facilitate maintenance:

- at all junctions, changes of gradient and changes of direction,
- at a maximum spacing of 30m along a length of pipe, and
- directly above any reflux valves, orifice plates or debris screens.

10. Inlet pits shall be installed at depressions and other locations to permit the entry of water into the stormwater pipes. Surface inlet pits or grated trench drains should be sufficiently large to accept the predict flow and positioned to ensure that for the pipe AEP:

- all runoff from roofed and paved areas is collected,
- runoff does not enter garages or buildings,
- long term nuisance ponding of stormwater does not occur,
- pedestrian access to buildings is not affected by significant flow depths,
- runoff from paved driveways and paths or concentrated runoff from grassed or landscaped areas does not flow over the public footway or onto adjoining properties.

11. Arrestors are installed to remove contaminants such as silt and oil from the stormwater before it discharges into Council's system. Any silt arrestor shall be designed in accordance with AS 3500.3.

12. Minimum pit sizes shall be in accordance with table D5.3. All pipes must be cut flush with the wall of the pit and grouted securely in place. Continuous trench drains are to be a minimum width of 150mm.

13. PVC pits will only be permitted if they are heavy-duty PVC pits not greater than 300mm x 300mm. Brick pits should be constructed on a 150mm thick concrete bed. The walls shall be internally rendered and should have a thickness not less than 230mm for wall depths less than 1.5m. Deeper pits shall have a wall thickness in accordance with figure 4.3 in AS 3500.3, or shall be designed by a qualified structural engineer using reinforced concrete. Concrete pits shall have a minimum wall thickness of 95mm for pre-cast pits and 150mm for cast-in-situ.

Pit Materials

14. Grates are to be galvanised steel grid type. Heavy-duty grates are to be used in areas where they may be subject to vehicle loading.

Rainwater Tanks

15. Design of dwellings and the provision for future dwellings shall include stormwater harvest and reuse based on roof area. Refer to the Wollondilly Water Sensitive Urban Design Guidelines for additional information on the required tank capacity. Rainwater tanks may not be appropriate where recycled water is available and will not be required.

BASIX Tank

16. Rainwater tanks shall be fitted with an overflow pipe that is connected to a property disposal point.

***Tank
Drainage***

D5.27 DISPOSAL OF PROPERTY STORMWATER

1. Disposal of collected stormwater runoff from the property drainage system shall be to a legal point of discharge. It should be checked that the proposed stormwater disposal method is permissible under the relevant Development Control Plan for the particular development type. Generally, there should only be one discharge point per site allotment.

***Legal Point of
Discharge***

Legal Point of Discharge for concentrated flows can be defined as:

a. A Natural Watercourse with definable stream bed and bank elements

In urban areas or areas where land use has degraded definable stream bed and banks, spatial data or maps may be used for evidence of a Hydro Line or "Blue Line" to define a historical watercourse location.

b. Overland flow path where it can be demonstrated that concentrated flows are able to be returned to the natural condition without impacting on the use of the downstream properties. This is generally only acceptable in large rural properties. Easements may be required over part of downstream properties.

c. Public Drainage System such as a road piped drainage, kerb and gutter, table drain, swale or a public piped system outside of the road network. Discharge limits may be applied for some drainage infrastructure such as kerb and gutter and table drains.

d. On site disposal where there is sufficient land or infiltration to disperse or dispose of concentrated flows collected during the minor storm event without impacting on the use of the downstream properties. The use of infiltration measures may be limited in small urban lots or where dwelling houses and other structures are within proximity.

Where a property is not directly connected to a legal point of discharge for the disposal of collected or concentrated stormwater runoff, an interallotment drainage system, with registered easements benefiting the subject property must be provided.

(a) Kerb and Gutter

***Kerb and
Gutter***

2. Maximum discharge to the kerb and gutter from the property drainage system during the design "minor" storm event is 25 L/s. The use of an OSD system may be required if discharge exceeds 25 L/s. Only one line will be permitted within the footway from each lot.

3. Discharge of property stormwater to the kerb and gutter where the peak flow is in excess 25 L/s will be considered where there is no reasonable alternative. Approval will be at the sole discretion of Council and shall include consideration of the quantity of flow being discharged, the potential impact on gutter flows in the vicinity of the outlet and the distance to Council's existing piped drainage system. Where approval is granted, the peak velocity of water discharging to the kerb shall not exceed 3.0m/s.

4. A single 100mm \varnothing sewer grade PVC pipeline may be used to convey collected runoff to the kerb. Where outflow exceeds the capacity of a single 100mm \varnothing pipe, a galvanised steel rectangular hollow section with a height no greater than 100mm shall be used. Multiple PVC pipelines across the footway will not be permitted.

5. The pipeline is to cross the footway at an angle no less than 60°. At the point of connection to the kerb, the invert of the pipe must match the invert of the kerb. The kerb is to be suitably made good at the point of connection.

6. The point of discharge to the kerb should be in front of the subject property at the lowest point in the kerb. A 150 mm x 50 mm hot dipped galvanised steel rectangular hollow section is to be provided for each lot that drains to street/kerb. Where footpath is constructed, the outlet should extend from the lot boundary under the footpath. These outlets are to be indicated on the stormwater drawings.

Kerb Outlet

7. Property disposal to kerb and gutter is limited to low density residential properties only. Medium density flats, townhouses, hostels and the like will be prohibited from connection to the kerb or table drain. Medium density housing, commercial and industrial developments must discharge to a piped drainage system.

(b) Connection to Council's Underground Drainage System

Existing Stormwater

8. Requirements for private pipes entering Council's piped drainage system are given below:

- All pipe inlets, including roof and subsoil pipes, shall where possible, enter the main pipe system at existing junction pits. These shall be finished off flush with and be grouted into the pit wall.
- If a junction has to be added which is larger than 225mm then a junction pit shall be built at this location in accordance with this specification. Where the new pit may be subject to vehicular traffic, it must not be able to transfer that load to the Council pipe.
- For smaller pipes, the drainage pipes may be broken into to allow interconnection with the main line. In this case, the side line shall be finished flushed with and be grouted into the main line.

Where these criteria cannot be satisfied, Council's drainage system may need to be extended to a point in front of the subject property. In this event, the pipe is to be a minimum 375mm \varnothing , laid within the roadway immediately in front of the kerb. A kerb inlet pit will generally be required in front of the subject property.

(c) Discharge to Open Channels or Watercourses

Open Channel

9. Discharge to a suitable natural watercourse or creek may be permissible subject to approval by Council. The watercourse is to be protected against scour at the point of discharge. Only a single point of discharge for the development will be permissible. In this regard an outflow apron and/or energy dissipater is to be provided to reduce velocity and erosion. Outflow dissipaters typically consist of concrete and rip rap, and should be angled 30 degrees to the direction of flow to reduce the likelihood of scour. Refer to Landcom's "Managing Urban Stormwater – Soil and Construction – Volume 1" (Blue Book) section 5.4.5 for additional details on energy dissipaters and outlet protection.

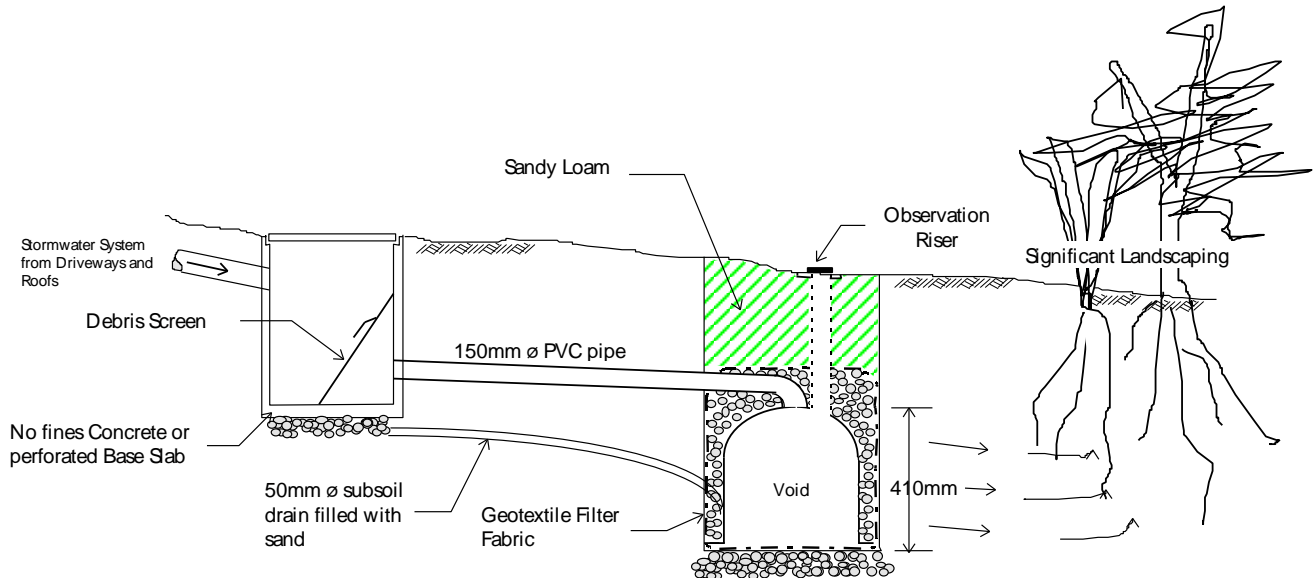
10. Council will not approve discharging runoff into bushland or recreation reserves. The water must be piped or conveyed in a suitably designed and constructed open channel to a well defined drainage path. Open channels can be rock lined with material similar to those in the local area and with riffles and stilling ponds to mimic more natural systems.

(d) On-site Absorption/Infiltration Trench

Absorption Trench

11. Single dwelling houses on existing lots that cannot pipe runoff to the street or do not have access to a suitable interallotment drainage easement, can discharge stormwater to an onsite absorption trench provided a grassed area is available-and:

- it is permissible under the relevant Development Control Plan,
- it is equal to the total plan area of all roofs and hard surfaces on the site,
- it is suitably located for the purpose and
- the soil type is suitable for the purpose.



12. Council will not support the use of on-site infiltration trenches/swales with the creation of new lots of less than 4000 m² unless it is part of a design as outlined in Wollondilly Shire Council WSUD Guidelines.

13. Infiltration trenches and swales used as part of a WSUD must provide for overflow disposal, up to the 10% AEP critical storm event to a piped or road drainage system.

14. An onsite absorption trench should be a minimum of 6.0 metres long, 0.6 metres wide and 0.6 metres deep. It should be sited parallel to the contours, as far as practicable from the property boundaries and a minimum of 3.0m from buildings. It should not be placed under any paved surface and should be at least 1.0m from pavements subject to vehicular traffic. A debris screen should be installed upstream of the trench. The trench is to be principally in accordance with the figure above.

(e) Pumps and Charged Lines

Pumps and Charged Lines

15. Pumps may only be used to drain seepage and a minor amount of direct runoff from a basement carparking area. Wet wells shall be designed and constructed in accordance with section 7.3 of AS 3500.3

16. Charged lines will only be permitted as the primary means of property stormwater disposal where other property disposal options are not available. Charged lines are not permitted for the subdivision of land greater than 3 lots.

17. Charged lines must not result in cross catchment discharge unless it can be demonstrated that there is sufficient drainage capacity in the receiving catchment.

18. Charged lines must be supported by other stormwater management measures to reduce discharge volume such as stormwater harvesting and reuse in rainwater tanks.
19. Charged lines are only permitted to the property boundary, after which gravity fed drainage must be provided, ie gravity fed across the road verge. A junction pit is to be provided at the boundary, prior to discharging to public drainage infrastructure.
20. If a charged line system is to be used, the design must include the following:
- Provision for de-watering
 - Connection to rainwater tank
 - Cleaning eye pit provided at the lowest point in the charged system
 - Sealed cleaning eye at suitable location at critical bends
 - Type 'P' pressure rated solvents to be used
 - Charged lines are not permitted outside of the property boundary
 - Discharge from the junction pit to the public drainage must be by gravity; no charged lines should directly attach to a kerb outlet
 - No surface inlet pits are to be connected to the charged system
 - A minimum height difference of 1.8 m between the RL of the gutter and the RL of the discharge pit must be provided to ensure there is sufficient pressure head.

(f) Piping through a Private Property

Easements

21. Pipes draining one property through another shall be sized to accommodate all collected runoff from the development site and shall be kept separate from the drainage system of the property through which it is passing.

22. Consideration must be given to the path taken by stormwater during extreme storm events. Where overflows could result in damage on adjoining properties, the pipes shall be designed to accommodate runoff from storms up to the 1% AEP event.

23. Where it is necessary to convey collected stormwater runoff from one lot through another, an easement must exist on the downstream lot that confers rights to the upstream lot to drain through it. Where the easement must be created to facilitate development, it is the responsibility of the applicant to negotiate with the affected property owners to secure the necessary easement(s). If it is proposed to discharge collected runoff to an existing interallotment pipeline or to lay a new pipe within an existing interallotment easement, the applicant shall submit information from the Land Titles Office to indicate the subject property enjoys rights to use the interallotment drainage system.

24. Refer to D5.17 of this design specification for details on interallotment drainage.

(g) Piping Through a Public Park

Parkland

25. Council has the sole discretion to approve or refuse an application to lay property drainage lines within a public park. Issues such as damage to the park, particularly the trees, will be considered.

D5.28 BUILDING ON LOTS BURDENED BY A DRAINAGE EASEMENT

- | | |
|---|---|
| <p>1. No buildings or structures will be permitted to encroach onto a drainage easement. Overhang of eaves and other structures may be permitted if it can be demonstrated that the structures will not impact on access or enjoyment of the easement. . Encroachments may be subject to approval or acceptance by the benefiting properties.</p> | <p><i>Easement
Encroaching</i></p> |
| <p>2. On-ground vehicular driveways will typically be permitted over an easement however the structural stability of the existing pipeline will need to be considered. Similar considerations will need to be made when it is proposed to reduce cover over the pipe. The driveway levels must not interfere with any overland flow function of the easement.</p> | <p><i>Driveways</i></p> |
| <p>3. Demountable carports and other easily removable structures that do not involve usable floor space may be approved over a Council drainage easement. If approval for such a structure is granted, the owner will need to enter a “deed of charge” with Council that the property owner will remove the structure at their own expense if Council deems it necessary for the purpose of accessing the easement. Any such approval will not extinguish or limit Council’s rights under the easement. The driveway and parking space levels must not interfere with any overland flow function of the easement.</p> | <p><i>Carports</i></p> |
| <p>4. Masonry Walls constructed across an easement must cross at an angle of not less than 60°. The section of wall spanning the easement shall be constructed to enable its easy removal without resulting in failure of the remainder of the structure.</p> | <p><i>Masonry
Walls</i></p> |
| <p>5. All footings for buildings and other structures shall be taken below the load-bearing zone of the existing pipeline. This shall apply even when the pipe is located on an adjoining property.</p> | <p><i>Footings</i></p> |
| <p>6. The zone of influence for a pipe shall be taken as a 45-degree angle from the invert level of the pipeline to the surface.</p> | <p><i>Zone of
Influence</i></p> |
| <p>7. At any time there is an existing, unsuitable encroachment onto a drainage easement, Council will take the opportunity to have the encroachment removed if and when it is presented.</p> | |
| <p>8. The exact location of a Council pipeline on the property should be confirmed. It should not be assumed that the will be located within the easement.</p> | <p><i>Pipe Location</i></p> |
| <p>9. Council may consent to the relocation of an existing Council pipeline through a property. Issues that will be considered will include, but not be limited to:</p> <ul style="list-style-type: none"> • the hydraulic efficiency of the re-aligned system, • the management of overland flows • maintenance costs. <p>Should Council consent to the relocation, all associated design, construction and relocation costs shall be borne by the applicant. A Council drainage easement will need to be created over the new line of pipe and any redundant easements are to be extinguished.</p> | <p><i>Pipe
Relocation</i></p> |
| <p>10. Council will consent to releasing or extinguishing a drainage easement if it can be demonstrated to Council’s satisfaction that it is redundant to existing or future stormwater management needs. Any requests of this nature must be in writing and all costs shall be borne by the applicant.</p> | <p><i>Releasing
Easements</i></p> |

MANAGING PROPERTY INUNDATION

D5.28 GENERAL

1. Where overland flow enters the property, due consideration must be given to the effects of that flow on persons and property, with a view to ensuring there is no increase in hazard or private and public losses resulting from inundation and ensuring the development is compatible with any mitigation strategies of Council.

2. The following key design principals must be considered when developing in flood affected properties or properties inundated by overland flows:

- Any work on the property must not increase the quantity or concentration of flow through an adjoining property or otherwise aggravate stormwater overland flow characteristics on adjoining properties. **Adjoining Properties**
- Site improvements must be designed to ensure there will be no significant damage caused by stormwater runoff through the property. **Damages**
- People, particularly children, must not be placed at risk by overland flow. Any development proposal must not modify the way in which overland flow is conveyed through a property in a way that makes it hazardous, or promotes the increased use of a property (or part of a property) that has an existing stormwater inundation safety hazard. **Safety**
- The proposal should not reduce the opportunity to undertake any reasonable options to redress existing overland flow problems. **Existing Problems**

D5.29 SUBDIVISION OF LAND AFFECTED BY OVERLAND FLOW

1. Subdivisions should be designed to ensure that, where possible, newly created lots will be free from flooding and stormwater inundation.

2. Overland flow paths through newly created private lots may be acceptable at the discretion of Council where the following criteria is met during the 1% AEP storm event:

- Flow depths do not exceed 0.2m
- Flow velocities do not exceed 2.0m/s
- The peak flowrate in the overland flow path does not exceed 3.0m³/s *
- A suitable building platform, has been identified on the subdivision plans, that is a minimum of 0.5m above the water level.
- The limit of the 1% AEP flowpath is identified on the linen plans and a restriction as to use is placed on the title of the lot preventing any alteration to the surface level or placement of any building, structure or unsuitable fence on the land effected by the flow.

NOTE * This flowrate refers to the greater of either: The 1% AEP flow less any piped flow in the minor system, or the 1% AEP flow less the flow from the design "minor" storm event. The figure is to include the total flow in the flowpath regardless of whether it is shared between more than one property.

D5.30 BUILDINGS ON FLOOD AFFECTED LAND

- 1. Due regard is to be given to the location and shape of proposed buildings on the land so as to minimise obstruction to overland flow. **Placement & Design**
- 2. Dwellings will not be permitted to bridge over a designed flow path due to the potential for blockage. In this regard, all building footprints and filling works shall be clear of **Building Over Flow Paths**

extent of 1% AEP floodway. Areas under buildings are NOT to be included when calculating impacts on adjoining properties, post developed flood depths, velocities or the like.

3. As buildings, fillings and structures are allowed in flood plain areas other than floodway limits of 1% flood, buildings and structures in such areas (eg. flood fringes of 1% AEP flood) are to be designed to withstand damage due to scour, debris or buoyancy forces.

4. Any openings into buildings are generally to be not less than 500 mm above the predicted design flood level. The floor level of lockup garages and sheds are to be at least equal with the predicted design flood level. These minimum freeboard values may be increased or reduced at the discretion of Council. Factors that will be considered in determining possible variation of freeboard are the flowrates, anticipated flow depths, potential damages in the event of inundation and the confidence in the hydrology/hydraulic prediction model. An adverse combination of factors may result in a freeboard of 500mm or greater being required.

Freeboard

5. Additions to existing buildings on properties affected by significant overland flow are to be designed using the criteria for to new buildings. Further, Council will not approve applications that involve significant capital expenditure improving an existing building that does not meet current minimum standards for overland stormwater management.

Additions & Alterations to Existing Buildings

6. The maximum depth through a designated carparking space or open carport is 180mm.

D5.31 FLOOD HAZARD

1. To satisfy restrictions pertaining to flood hazard, both depth x velocity (D.V) limits and safe water depth limits should be observed. These limits must be strictly observed when designing flowpaths on medium density residential property developments. There may be scope to relax the safety criteria standards on properties containing single residential dwellings, commercial developments and industrial developments depending on the number of children the development is likely to attract. Such relaxation of the standards are at the discretion of Council.

2. The peak depth x velocity product of stormwater runoff through areas accessible to children shall be limited to 0.4m²/s. Such areas include driveways, carparking spaces, pathways and courtyards.

Depth x Velocity Product

3. The degree of hazard resulting from relatively deep, slow moving or still water, is dependant on the grades of the land adjacent to the waters edge, and progressing into deeper water. Acceptable water depths are outlined in the table below.

Approach Grade to Maximum Depth	Maximum Depth (m)
Greater than 1:4	0.3
1:4 to 1:15	0.8
Less than 1:15	No Maximum

4. Safety fencing necessary to restrict access to areas affected by hazardous flows shall meet the minimum standards outlined in AS1926.1-1993 "Fencing for swimming pools". The fenced off area will not be considered as open space for the purposes of calculating minimum private open space requirements as outlined in the relevant planning instruments. Where the property is to be a strata subdivision or community title subdivision, the fenced off area of land should be nominated as common property and direct access should only be available from common property.

Safety Fencing

5. Developments with a potential to promote the increased use of a property (or part of a property) burdened by hazardous flows, may be considered inappropriate for the site depending on issues such as the extent of property affectation and the amount of usable private open space not affected by hazardous flows. This may result in some properties being considered unsuitable for medium density residential development by virtue of them being burdened by hazardous stormwater inundation during major storm events.

6. Where appropriate applications may be required to demonstrate to Council that permanent, fail-safe, maintenance-free measures are incorporated in the development to ensure the timely, orderly and safe evacuation of people in the event of a flood. Such evacuation measures are to be designed for rainfall events of more than 1% AEP.

D5.32 MISCELLANEOUS FLOOD MANAGEMENT ISSUES

1. Boundary or internal fences should not obstruct the natural path of overland flow. All fences located within an overland flow path shall be permeable, i.e. allow water to freely pass through them. In most instances, only the lower portions of the fence will need to be permeable. Fences must be permeable to at least 100mm above the calculated top water level.

Fences

2. The coping level of any in-ground swimming pool is to be at or above the top water level of the 20% AEP storm event. The impact of the pool structure on the flow characteristics will need to be considered.

In Ground Pools

3. Where it is proposed to collect overland flow and pipe it through the development, consideration must be given to the potential for the inlet to become blocked. Where this will result in unacceptable flows through the property, suitable measures must be taken to minimise the risk of inlet blockage.

Blockage of Inlet

WATER SENSITIVE URBAN DESIGN

D5.33 GENERAL

1. Stormwater shall be managed in an integrated manner with equal consideration of water quality and quantity.

2. For water quality, a zero-impact approach is to be achieved in accordance with the Wollondilly Integrated Water Management Policy.

3. Measures adopted from the Water Sensitive Urban Design Guideline aim to manage stormwater volume runoff. All developments must achieve the required outcomes as outlined in the WSUD Guidelines.

4. Each development will determine a treatment train to reduce stormwater volume runoff. Treatment should include measures as outlined in the WSUD Guidelines and may include a distributed treatment train throughout the development or a single treatment train for smaller developments.

5. The design of treatment elements shall be generally as outlined in the WSUD Guidelines. Elements not detailed in the guidelines should be designed to minimise maintenance requirements. The design of specific elements is also outlined in D5.34.

D5.34 DESIGN OF TREATMENT ELEMENTS

Gross Pollutant Traps

- | | |
|---|-------------------------------------|
| <p>1. Gross pollutant traps (GPTs) are permanent structures used to trap coarse sediments, trash, litter, and other floating materials. Usually, they are located upstream of constructed wetlands and receiving waters. They consist of an energy dissipater at the upper end, concrete sediment trap and trash rack at the lower end. Sometimes a "mini" wetland is incorporated at the downstream end.</p> | Description |
| <p>2. These traps have restricted application and each should be justified on individual merits. They have high construction costs and are generally unable to trap silt and clay sized particles other than in relatively small storm events (eg, 1 EY, critical duration storm event). Nevertheless, in some specialised situations their use might be justified, especially where a significant proportion of the bed load consists of particles coarser than 0.04mm (sandy soils) and/or where their construction/maintenance cost can be justified when compared with more conventional sediment retention basins.</p> | Applications |
| <p>3. GPTs can be defined as major or minor:</p> <ul style="list-style-type: none"> (a) major gross pollutant traps can be located on major floodways and waterways to intercept medium to high flows; and (b) minor, enclosed gross pollutant traps can be located at heads of major floodways and/or where stormwater discharges into floodways or water bodies. | Definition |
| <p>4. GPTs can be categories into either wet sumps or dry sumps.</p> <ul style="list-style-type: none"> • Wet sump GPTs are below the standing water level, resulting in permanent inundation. Maintenance costs are typically higher as the collected wet wastes are classified as toxic liquids. Additionally, if not maintained frequently, there is risk of by-products from biochemical reactions to wash downstream and into waterways. Dry sump GPTs sit above the standing water level and are self-draining. Maintenance costs are typically cheaper as collected pollutants can be disposed to local landfill. For this reason, dry sumps are preferred. | Categories |
| <p>5. Design traps to intercept at least 75 per cent of sediment with a grain size of 0.04mm or greater under average annual runoff conditions. Further, ensure peak flow velocities are less than 0.3 metres per second in the 1 EY storm event, and taking into account any likely backwater effect from a blocked trash rack.</p> | Sediment Interception |
| <p>6. The structure should have sufficient capacity and stability to discharge the inlet flow with the trash rack fully blocked without flooding adjacent properties.</p> | Capacity |
| <p>7. Ensure GPTs are capable of gravity drainage to a dry condition for periodic cleaning and maintenance if at all possible. The GPT should also be designed to allow cleaning by a vacuum suction truck, limiting the need to enter the unit.</p> | Maintenance Requirement |
| <p>8. Where a GPT is included as part of development works the Developer shall be responsible for cleaning and maintenance of the device, where not included in a Voluntary Planning Agreement, for a period of three (3) years from the date of Certificate of Practical Completion. A maintenance and cleaning bond shall be lodged with Council at the time of issue of Certificate of Practical Completion equivalent to 10% of the installation cost or a minimum \$5000. At the end of the maintenance period the device must be cleaned and any defects repaired prior to hand over to Council.</p> | Developer Maintenance Period |
| <p>9. If a GPT is located within an easement, there should be provision for access by a vacuum truck for cleaning.</p> | |

Rainwater Tanks

- 10. All new dwellings shall be fitted with a BASIX rainwater tank of no less than 4,000 litres capacity or as outlined in the WSUD Guidelines. Refer to the WSUD Guidelines for to minimum required tank capacity for a given roof area.
- 11. Rainwater tanks shall be fitted with an overflow pipe that is connected to a property discharge point.
- 12. Newly created lots shall make provision for BASIX rainwater tank of no less than 5,000 litres capacity with the creation of a restriction on the use of land that no dwelling be permitted unless a rainwater tank is fitted.

D5.35 MAINTENANCE

- 1. The developer shall be responsible for cleaning and maintenance of all water quality and detention systems including detention pits, GPTs, bio-retention ponds and filtration pits for a period of three (3) years from the date of Certificate of Practical Completion for the development or the last stage of the development or for any period specified as part of a Voluntary Planning Agreement.
- 2. Where a GPT is implemented as a part of a development the Developer shall be responsible for cleaning and maintenance of the devices or measures, where not included in a Voluntary Planning Agreement, for a period of three (3) years from the date of Certificate of Practical Completion. A maintenance and cleaning bond shall be lodged with Council at the time of issue of Certificate of Practical Completion equivalent to 50% of the installation cost or a minimum \$5000. At the end of the maintenance period the devices or measures must be cleaned and any defects repaired prior to hand over to Council and release of bond.

***Developer
Maintenance
Period***

***Developer
Maintenance
Period***

INTEGRATED STORMWATER MANAGEMENT MODELLING

D5.36 VOLUME MANAGEMENT

Volume Management

1. The controls surrounding Volume Management are generally outlined in the Wollondilly WSUD Guidelines.
2. Modelling and design shall be performed using the base MUSIC model provided Council.
3. Storm events for must be using climatic data from BoM's Rookwood weather station.
4. Site specific variations from the guidelines must be outlined for considered by Council
5. Key requirements are outlined below.
 - a) Soil testing shall be provided to determine the in-situ pre-development soil profile and soil infiltration rates. This will be used to determine the existing condition.
 - b) Outputs of the MUSIC model should be a comparison of the volume in ML per year per hectare (ML/Y/Ha).
 - c) Assessment of the MUSIC model output will be looking at how closely the pre and post development conditions match and whether the volume is close to the targets as out lined in the WSUD Guidelines.

D5.37 PEAK FLOW MANAGEMENT***Peak Flow
Management***

1. The controls surrounding Peak Flow Management are generally outlined in the Wollondilly Shire Council Design Specification part D5. This is what would be considered the traditional stormwater management requirements around quantity.
2. Management of stormwater runoff volumes will assist with the management of peak flow management.
3. Modelling and design shall be performed using the methods outlined in ARR 2019. Storm events for modelling must be as per the ARR and BoM data for storm ensembles.
4. Key requirements are outlined below.
 - a. Management of peak flows must be managed to ensure post development flows mimic the pre-development condition up to the 1% AEP critical storm event.
 - b. Management of minor system peak flows, up to the 10% AEP, as calculated from the methods outlined in ARR 2019, to be checked to ensure road and lot drainage are designed to manage nuisance stormwater runoff.

There shall be no road water entering private lots or pedestrian areas such as footpaths. Roads are to remain clear and trafficable by limiting flow or inundations widths within the road carriageway, and parking areas, in accordance with part D5.09.

- c. The major System flooding, property and infrastructure protection, up to 1% AEP, as calculated from the methods outlined in ARR 2019, will need to be checked to ensure safe flow of water through roads and property etc.

There shall be no concentration of flows from the development site and no change to flood extent or overland flows through adjacent properties.

Compliance checks can be presented as a 2D model with outputs showing Velocity Depth product, overland flow paths and extent, depth of flow for pre and post development conditions.

Velocity Depth product is to meet the requirements of part D5.12 of the specification.

STANDARD DRAWINGS**D5.100 LIST OF DRAWINGS***List of Drawings*

1.	DRAWING NUMBER	DRAWING DESCRIPTION
	WSC.D5.3	Components for Miscellaneous Pits
	WSC.D5.4	Precast Components for Kerb Inlet Gully Pit to WSC.D5.5
	WSC.D5.5	Standard Kerb Inlet Gully Pit
	WSC.D5.6	Standard Junction Pit
	WSC.D5.7	Standard Grated Gully Pit in Concrete Accessways
	WSC.D5.8	Concrete Inspection Pit and Minor Drainage Details
	WSC.D5.9	Not Included
	WSC.D5.10	Standard Grated Kerb Inlet Pit
	WSC.D5.11	Standard Surcharge Pits
	WSC.D5.12	Standard Pathway Grated Pit

DESIGN
SPECIFICATION

D6

SITE REGRADING

Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Wollondilly Shire Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Water Catchment Boundaries	D6.05	A	DC	1/07/22
2	Revegetation of Lots	D6.06	A	DC	1/07/22
3	Quality of Imported Fill	D6.07	A	DC	1/07/22
4	50 mm Topsoil Dressing	D6.07	A	DC	1/07/22
5	Design of Retaining Walls	D6.13	A	DC	1/07/22
6	Lot and Batter Grades	D6.14	A	DC	1/07/22

**SPECIFICATION D6 : SITE REGRADING
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SPECIFICATION D6 : SITE REGRADING

GENERAL

D6.01 SCOPE

1. This design specification sets out requirements for the site regrading involved in land development and subdivision. Conceptual requirements are presented as necessary considerations when preparing designs for site regrading.

2. The scope of this specification assumes that the Designer is familiar with requirements cited in the various construction specifications, specifically those related to earthworks, clearing and grubbing, erosion and sedimentation. Additionally the Designer needs to make reference to the associated design specifications related to stormwater drainage design, geometric road design and erosion control and stormwater management.

***Familiarity
with other
Specifications
Required***

D6.02 OBJECTIVES

1. This specification aims to assist the Designer in achieving:

- efficient and economical design
- enhancement of the environmental character of the site whilst maintaining the natural features of the site
- provision of safe conditions for construction commensurate with the proposed purpose of the development
- equality of building conditions for residential development
- a minimal impact on adjoining properties and developments.

Efficient

Environmentally Sound

Safe for Construction

Impact on Adjoining Properties

D6.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

Construction Specifications

Wollondilly Shire Council Construction Specification

Design Specifications

- | | | |
|----|---|---|
| D1 | - | Geometric Road Design |
| D5 | - | Stormwater Drainage Design |
| D7 | - | Erosion Control and Stormwater Management |

(b) Australian Standards

- AS 3798 - Guidelines on earthworks for commercial and residential developments
- AS 2870.1 - Residential slabs and footings - Construction.

D6.04 SITE REGRADING CONCEPT

1. Areas of a site proposed for building or recreational purposes may not be suitable in their natural state for their intended function without improvement works to:

- (a) Alleviate flooding of low-lying ground
- (b) Fill gullies or create emergency flowpaths after underground stormwater piping has been installed
- (c) Allow improved runoff from flat ground
- (d) Regrade excessively steep slopes that would preclude economical construction of dwelling foundations
- (e) Allow effective recreational use or give reasonable access

The Consultant shall review the natural surface contours and where necessary shall design finished surface levels that ensure the land is suitably prepared

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

Drainage

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

Natural Environment

4. Care shall be taken to provide depressions for overland flow from low points and over major drainage lines, to direct stormwater for storms up to a 100 year average recurrence interval.

Overland Flow

5. The design of site regrading areas in conjunction with the design of roadworks shall be considered with the objective of balancing cut to fill and achieving both an economical development and minimising haulage of imported fill or spoil to and from the development site. Bulk haulage should always be considered an adverse effect on adjacent development, and infrastructure.

Minimal Road Haulage

D6.05 SPECIAL TREATMENT OF PARTICULAR AREAS

1. Subject to Council approval and meeting all requirements for managing floodwaters and overland flows outlined in the Design Specification D5 STORMATER DRAINAGE, areas abutting flooding or nuisance drainage sites shall be site regraded to a minimum level of 0.5 metres above the 1% AEP Flood levels. The site shall be identified on the design plans with appropriate notation of site specific requirements.

Flooding

2. In the event that an area is known to be affected by or inundated by local stormwater flows, the Designer shall investigate the existing conditions as they relate to the proposed development and advise the Developer in the preliminary design report on all data obtained in the investigation and recommend appropriate contour adjustments. The report should normally be accompanied by sketch plans to clarify recommendations.

Inundation Areas

- | | |
|--|---|
| <p>3. Site constraints either natural or otherwise may be required to be identified as a burden on developed property. It is recommended that the designer take this into account when preparing the design. The property may ultimately be affected by a "restriction as to user", which may be controlled by a legal 88B Instrument placed on title to the land and/or by a Section 149 message advising prospective purchasers of any restrictions affecting the land.</p> | <p><i>Restrictions on Land Use</i></p> |
| <p>4. The finished surface of filled areas shall be designed to levels allowing an adequate cover depth over the pipeline (if piped) and permitting surface stormwater flow to be guided to inlet pits if depressions are retained in the finished surface contouring.</p> | <p><i>Piped Gullies or Depressions</i></p> |
| <p>5. The location of such features shall be clearly defined on the site regrading plans and defined by distance to corner boundaries, monuments, etc for purposes of relocation at the geotechnical testing stage for work as executed plans. A geotechnical report specifying the site specific preparation and compaction requirements will be required to be incorporated with the site regrading plan. A description of the minimum acceptable quality of the fill shall also be specified on the plans, supported by geotechnical recommendations. All documentation necessary from various authorities to support the filling of dams and watercourses shall be supplied with the design plans.</p> | <p><i>Dams and Water Courses</i></p> |
| <p>6. Cut and fill should not alter the boundaries of natural water catchments, that is, reshaping of land should not move water from one catchment to another.</p> | |
| <p>7. The finished level of any building area shall be designed to ensure a desirable surface grading of 1.5% (1% minimum) oriented in the direction of the drainage system designed to cater for its catchment.</p> | <p><i>Flat Ground</i></p> |
| <p>8. Building areas containing natural ground slopes of an excessively steep nature, ie greater than 15% shall be brought to the attention of a Geotechnical Engineer for investigation of compatibility with dwelling types proposed. Specific requirements shall be noted on the design plans.</p> | <p><i>Steep Slopes</i></p> |
| <p>D6.06 GENERAL STANDARD OF LOT PREPARATION</p> | |
| <p>1. Special requirements will apply where necessary but generally lots are to be cleared of low scrub, fallen timber, debris, stumps, large rocks and any trees which in the opinion of Council are approaching the end of their functional life or are dangerous or will be hazardous to normal use of the development. Prior consultation with Council's Development Branch is necessary. Such requirements shall be shown on the design plan.</p> | <p><i>Clearing</i></p> |
| <p>2. All timber and other materials cleared from lots shall be removed from the site. All roots, loose timber, etc which may contribute to drain blockage shall be removed. Such requirements shall be shown on the design plan.</p> | <p><i>Disposal</i></p> |
| <p>3. Selected trees shall be preserved by approved means to prevent destruction normally caused by placement of conventional filling or other action within the tree drip zone. AS 4970-2009 shall be followed for the protection of trees on development sites. The relevant Council officer shall be consulted for advice and all specific requirements noted on the design plans.</p> | <p><i>Preservation of Trees</i></p> |
| <p>4. Lots should be revegetated with suitable grasses after regrading and levels are final.</p> | <p><i>Revegetation</i></p> |

D6.07 STANDARD OF FILL FOR LOTS

- | | |
|--|----------------------------------|
| 1. The following notations are to be incorporated in the design plans. "Filling is to be of sound clean material, reasonable standard and free from large rock, stumps, organic matter and other debris." "Placing of filling on the prepared areas shall not commence until the authority to do so has been obtained from the Council". | <i>Fill Quality</i> |
| 2. If fill is imported to the site, it should be accompanied by an endorsement from an Accredited Professional that the material is classified as either virgin excavated natural material (VENM) or excavated natural material (ENM). Additionally, the imported fill should be free from contaminants including asbestos. | <i>Imported Fill</i> |
| 3. All work shall be in accordance with AS 3798. Fill is to be placed in layers not exceeding 150mm compacted thickness. All fill is to be compacted to not less than 95% standard maximum dry density. Maximum particle size shall be 2/3 of the layer thickness. | <i>Compaction</i> |
| 4. Fill comprising natural sands or industrial wastes or by-products will be accepted by Council only in approved locations and will be subject to specific requirements determined by prevailing conditions. | <i>Restricted Fill</i> |
| 5. It is essential that prior advice be given of intended use of such materials. It should be noted that failure to obtain Council's approval may lead to an order for removal of any material considered by Council or other relevant authorities as unsuitable or in any way unfit for filling. | <i>Prior Approval</i> |
| 6. All areas where filling has been placed are to be dressed with a minimum of 50 mm of clean arable topsoil, fertilised and sown with suitable grasses. | <i>Top Dressing</i> |
| 7. Tests shall be taken on any proposed filling materials to ensure that they do not have a high dispersion potential as defined by the Emerson Crumb Dispersion Tests (AS1289 C8.1 – 1980 as amended). | <i>Dispersion Testing</i> |

D6.08 TEMPORARY DIVERSION DRAINS

- | | |
|---|-----------------------|
| 1. Where temporary drains are required to divert surface flows away from the site regrading area, the location and silt/erosion control treatment shall be clearly identified on the engineering plans. The scale of such works shall reflect the volume of water to be diverted. | <i>Erosion</i> |
|---|-----------------------|

The objective will be to ensure minimal soil disturbances and material loss off the site.

Control measures will include, but not be limited to:

- (a) Provision of trench stops every 30m along a trench, with provision for overtopping to be directed to the kerb.
- (b) Placement of "blue metal" bags along kerb and gutter at maximum 30m spacings.
- (c) Placement of "blue metal" bags around downstream drainage pits.

The requirements identified in Council's current Specification for Sediment & Erosion control should be addressed for any additional requirements.

D6.09 CONCURRENCE WITH THE ENVIRONMENTAL PROTECTION AUTHORITY (EPA)

1. The Consultant is recommended to refer to the EPA with regard to any items requiring specific consideration when preparing a site regrading plan. Such plans may need to incorporate sediment/siltation/erosion control devices with specific reference to the stage at which these are to be provided. The responsibility shall rest with the consultant/developer to make enquiries with EPA and subsequently obtain Council approval to proposed measures.

EPA

D6.10 WORK AS EXECUTED PLANS

1. The Consultant shall annotate on the site regrading plan, the site specific detail to be shown on the Work-as-Executed plans. Such detail shall include geotechnical report certifying the works to be suitable for the intended purpose and any other certifications, testing and survey data, as required in this specification.

D6.11 CARTAGE OF SOIL

1. The Consultant shall refer to Council for acceptable haul roads with applicable load limits. This detail shall be required to be shown on the site regrading plan. The payment of a Bond may be required by the developer/contractor where Council has some concern about the ability of a haul road to sustain the loads without undue damage or maintenance requirements.

Possible Bond Requirement

2. Unless specific application is made to Council and approval obtained, the plans will be annotated as follows:

Topsoil

"All topsoil shall be retained on the development site and utilised effectively to encourage appropriate revegetation."

D6.12 PERMIT TO ENTER TO DISCHARGE STORMWATER/CONSTRUCT

1. Where it is proposed to divert, direct or intensify the flow of stormwater into adjoining property, a "permit to discharge stormwater" shall be sought and submitted to Council prior to the approval of Engineering design plans. The above shall apply unless otherwise specified by Council. A permit shall also be sought to carry out construction work on adjoining property and such permit also presented to Council.

Permit Required

D6.13 RETAINING WALLS

1. All retaining walls are to be designed under the provisions of AS4678 Earth-retaining structures.

2. Retaining walls are to be constructed during the subdivision works.

Staging

3. The maximum height for interallotment retaining walls should be 1.2 m.

Maximum Height

4. Retaining walls within 0.5 m of a property boundary, it should have a maximum height of 1.0 m.

5. A minimum distance of 300 mm behind the retaining wall should be free draining granular backfill or no fines concrete to allow drainage of water.

Backfill

6. A minimum 100 mm diameter slotted and flexible ag pipe with geofabric sock to be installed behind retaining wall. Subsoil drains to be connected to pits if a pit is located nearby the retaining wall outlet. If no drainage pit is nearby, the subsoil may be connected to the kerb using a kerb outlet.

Drainage

7. The design of retaining walls in the front of dwellings should be designed to have a minimal impact on the streetscape.

Minimal Impact

D6.14 LOT REGRADING

1. Where fill is required to provide suitable building areas, the natural topography and grading of the site must be considered. Benching and terracing of lots should be done using minimum retaining wall and benching height rather than levelling the site with large retaining walls.

Fill Limitations

2. Cut of land should not exceed 2.0 m below natural ground level.

Cut Limitations

3. Lots are to be graded to ensure no ponding of water and that all water drains to one of the following: ***Lot Drainage***
- Street kerb and gutter via natural surface runoff
 - Pipe and pit interallotment drainage connected to the street drainage system
 - Water Sensitive Urban Design feature
4. Lots to have a minimum grade of 1.0% towards the lot drainage. ***Minimum Grade***
5. Batters on private property shall be no steeper than 1V:4H, unless otherwise supported by a geotechnical report. ***Batter Grade***
6. Batters which extend into areas subject to inundation are to be no steeper than 1V:6H

DESIGN
SPECIFICATION

D9

**CYCLEWAY AND
PATHWAY DESIGN**

Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Wollondilly Shire Council's primary amendments.

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Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	AUSTROADS Reference	D9.03	A	DC	1/07/22
2	Minimum Design Standards	Table D9.1	M	DC	1/07/22
3	Provision of footpath on both sides of the street	D9.05	A	DC	1/07/22
4	Design Requirements	D9.10	A	DC	1/07/22

SPECIFICATION D9 : CYCLEWAY AND PATHWAY DESIGN

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SPECIFICATION D9 : CYCLEWAY AND PATHWAY DESIGN

GENERAL

D9.01 SCOPE

1. This specification sets out requirements to be used in the design of various types of cycleways and pathways.

2. All relevant design principles contained in the AUSTRROADS Guide referenced below must be integrated in the design of cycleways and associated infrastructure. This specification serves as a companion document to the AUSTRROADS Guide extended to incorporate basic requirements for pathways.

AUSTRROADS

D9.02 OBJECTIVES

1. Wollondilly Shire is committed to an alternative transport network as a viable option for travel throughout the Shire. Provision of these services as an integrated part of all development is actively supported. Wherever possible, pathways for pedestrian and cycle transport shall be considered at the inception of a development proposal concept.

**Development
Integration**

2. This specification aims to set standards and document requirements related to the provision of cycleways and pathways which encourage pedestrian activities and cycling for transportation and recreational purposes. Cycleways and pathways are to be safe and convenient and shall maintain a satisfactory level of service for all pathway users.

Safety

**Level of
Service**

D9.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

D1 - Geometric Road Design

(b) Australian Standards

AS 1428.1 - 2001 Design for access and mobility
AS 1742 - Manual of uniform traffic control devices.
AS 2890.3 - Bicycle parking facilities

(c) Other

CYCLE PLANNING - Wollondilly Council Precinct 3 Cycleways Study
- Final Report October, 1993

Transport for NSW - Walking Space Guide (July 2020)

AUSTRROADS - Guide to Traffic Engineering Practice - PART 13
Pedestrians, PART 14 Bicycles.

- Planning and Designing for Bicycles - NAASRA (now
AUSTRROADS) Technical Report June 1988.

- Guide to Road Design Part 6A: Paths for Walking and
Cycling, 2021

Ministry of Transport, Victoria - State Bicycle Committee
- Planning and Design of Bicycle Facilities,

D9.04 CONSULTATION

1. The Designer is encouraged to consult with Council, the Developer's Landscape Architects/Designers and relevant authorities prior to and during the preparation of cycleway and pathway design.

***Landscape
Designers
Public
Authorities***

D9.05 PLANNING CONCEPTS

1. Provision of cycleways and pathways must be considered as part of all developments. Generally, developments proposing new roads will need to make provision for pathways along the new roads. Developments resulting in a significant increase in pedestrian or bicycle traffic, based on a traffic generation assessment, will need to make provision for cycleways or pathways. Cycleways and pathways should be extended to connect to existing networks where possible and may require upgrade of existing pathway networks in order to meet higher traffic demands.

***Pathway
Planning***

Where developments propose using existing road infrastructure or have minimal impact on pedestrian or bicycle traffic, then the provision of pathways may not be required. Isolated or unconnected sections of cycleway or pathways should be avoided where possible unless there possibility of future integration with Council's pathway Infrastructure Planning Schemes.

2. The Designer should be familiar with cycleway and pathway geometric design requirements in terms of:

***Geometric
Design***

- width
- grade
- stopping sight distance
- change in grade
- horizontal curvature
- crossfall and drainage
- superelevation
- sight distance on horizontal curves

***AUSTROADS
Guide***

These requirements are discussed in the AUSTROADS Guide and in Australian Standard AS.

3. Footpaths must be provided on both sides of the road to ensure adequate pedestrian connectivity and to encourage the use of alternate modes of transport. Shared paths should be considered at critical locations where cycle links can be provided.

***Footpath
Provision***

D9.06 CYCLEWAY AND PATHWAY TYPES

1. Cycleways can be provided on road and off road. The AUSTROADS Guide provides detailed descriptions, warrants, widths, pavement marking etc for the majority of these cycleways.

***On Road Off
Road***

2. Common alternative cycleway types include:

On Road

- Shared Parking/Bicycle Lanes
- Wide Kerbside Lanes
- Shared Traffic Lanes

Exclusive Bicycle Lane
Sealed Shoulder

Off Road

Shared Bicycle/Pedestrian Pathway
Segregated Pathway
Exclusive Cycleway

The AUSTRROADS Guide provides advice on the suitability of pavement conditions, drainage pit grates etc for on road cycleways.

**AUSTRROADS
Guide**

3. Common pathway types include:

Exclusive Pedestrian Pathways
Shared Bicycle/Pedestrian Pathways

By definition pedestrian pathways are "off road" in that pedestrian facilities routinely designed adjacent to roadways are termed footpaths and are designed to meet criteria outlined in Council's Subdivision Code and typically related to road cross section detailing.

Footpaths

4. Pathways by comparison diverge from the road alignment either within the road reserve or across land reserves. Pathways can be provided in conjunction with overland floodways or retention basins.

Land Reserves

D9.07 PROVISIONS FOR CYCLEWAYS AND PATHWAYS AT STRUCTURES

1. Designers shall consider the best way to cater for the uninterrupted movement of cyclists and pedestrians at proposed and existing structures wherever possible. Structures include bridges and underpasses over rivers, roads or railways. The AUSTRROADS Guide provides information on:

**Bridges
Underpasses**

- acceptable widths and clearances
- types of cycleways and pathways
- handrails
- bicycle bridges
- approach ramps
- etc.

D9.08 SIGNAGE AND PAVEMENT MARKING

1. The Designer shall provide adequate signposting design for cycleways and shared pathways.

2. Signs and pavement marking will provide for the safe and convenient use of the facility. The signs and pavement marking will comply with AS 1742.

**Signs
Pavement
Marking**

D9.09 END OF JOURNEY FACILITIES

1. Consideration must be given to the design of adequate facilities at common destinations of bicyclists and pedestrians so as to encourage cycleway and pathway usage.

2. Such facilities could include:

Facilities

- seats

- standby areas
- secure bicycle parking
- picnic facilities

3. Bicycle parking installation design should meet appropriate criteria discussed in the AUSTROADS Guide and be fabricated to meet AS 2890.3. **Parking**

D9.10 DESIGN STANDARDS

1. Notwithstanding the guidelines provided in this specification and referenced documents the following minimum standards have been determined as shown in Table D9.1.

Table D9.1 Minimum Design Standards

	Cycleway	Pathway(Pedestrian)	Shared Pathway
Path Width	2.0m	1.5 m	2.5m (min)
Formation Width	3.0m	2.0m	3.5m
Crossfall (refer Note)	min. max.	1:40 1:20	1:40 1:20
Concrete Thickness	125 mm	125mm	125 mm
Concrete Strength	M25	M25	M25
Reinforcement	SL82 - 40 mm cover	SL72* - 40 mm cover	SL82 - 40 mm cover
Preparation	Min 100 mm DGB20 or crusher dust on compacted subgrade	Layer of sand 100 mm on Compacted subgrade	Min 100 mm DGB20 or crusher dust on compacted subgrade
Joint Intervals	Saw cut at max 3 metres and dowelled expansion joint at 9 m	Saw cut at max 3 metres and dowelled expansion joint at 9 m	Saw cut at max 3 metres and dowelled expansion joint at 15 m
Joint Width	Saw cuts – 3-5 mm Dowelled expansion joint – 12 mm	Saw cuts – 3-5 mm Dowelled expansion joint – 12 mm	Saw cuts – 3-5 mm Dowelled expansion joint – 12 mm
Joint Depth	Saw cuts – 25 mm	Saw cuts – 25 mm	Saw cuts – 30 mm
Dowel Length	600 mm with 300 mm penetration into each slab	600 mm with 300 mm penetration into each slab	600 mm with 300 mm penetration into each slab
Dowel Diameter	16 mm	12 mm	16 mm
Dowel Spacing	450 mm CTS	450 mm CTS	450 mm CTS
Concrete colour	As advised by Council	As advised by Council	As advised by Council
Clearance Horiz.	2.5m	2m	2.5m
Minimum headroom	3.0 m	3.0 m	3.0 m
Distance from property boundary to closest edge	600 mm	600 mm	600 mm
Grade	max.	2% for 450m 5% for 90m 10% for 30m	In accordance with AS1428 and Building Code Australia where reasonably practicable.
			2% for 140m 3% for 70m 4% for 40m 5% for 30m

Note: Council has adopted a Disability Action Plan that aims to ensure all new buildings & facilities provided and major refurbishments undertaken are fully accessible. Geometric design and construction of new pathways shall comply with the requirements of AS1428 and the Building Code of Australia where reasonably practicable.

* For pedestrian pathways with a width greater than 2 m, SL82 mesh should be used in place of the SL72 mesh.

- | | | |
|----|---|--------------------------------------|
| 2. | Some shared pathways in parks and stormwater maintenance locations will need to be trafficable to allow access for maintenance vehicles. | <i>Maintenance Access</i> |
| 3. | Where possible, street trees should be placed perpendicular to path joint. Root control barriers to be used for trees adjacent to footpaths. | <i>Street Trees</i> |
| 4. | Saw cuts to be made within 24 hours of placement, or as soon as practical. | <i>Saw Cuts</i> |
| 5. | One end of each dowel should be capped or tapered. | <i>Dowel Capping</i> |
| 6. | Where a new path or cycleway ties into an existing path or cycleway, a doweled expansion joint should be used. | <i>Existing Paths</i> |
| 7. | Pram ramps are to be designed, formed up and constructed as a single concrete pour, integrated with the gutter. The pour should be done separately to the adjacent footpath. Ramp, wings and gutter to be coloured yellow. Refer to Wollondilly Shire Council standard drawing WSC.D1.17 for details. | <i>Pram Ramps</i> |
| 8. | Street trees are not to be removed for footpaths without prior consent from Tree Management Officer. No tree roots are to be severed without a Level 5 Arborist on site and permission given prior to works being carried out. | <i>Street Tree Management</i> |

D9.11 DOCUMENTATION

- | | | |
|----|---|------------------------------|
| 1. | The following listing outlines Council's minimum requirements for presentation of cycleway and/or pathway designs. | |
| • | All plans for cycleways/pathways are to be presented at the reduction ratio 1:500. | <i>Plans</i> |
| • | The cycleway plan sheet may be incorporated into the road plan where clarity permits. Specific details are to be provided at reduction ratio 1:200. | |
| • | Longitudinal Sections will be required for all off-road cycleways where grades exceed 4%. | <i>Long Sections</i> |
| • | Longitudinal Sections will have reduction ratios of 1:500 horizontal and 1:100 vertical. | |
| • | Cross Sections will be presented at 1:100 reduction ratio (natural) and transition tables will be required where crossfalls vary or superelevation is provided. | <i>Cross Sections</i> |
| • | A typical cross section will be detailed to indicate pavement materials and layer depths. | |

SPECIAL REQUIREMENTS

- D9.12 RESERVED
- D9.13 RESERVED
- D9.14 RESERVED

STANDARD DRAWINGS

- D9.100 LIST OF DRAWINGS
- 1. DRAWING NUMBER DRAWING DESCRIPTION

List of Drawings

WSC.D9.1 Typical Pavement Details for Concrete Shared Footpath/Cycleway

DESIGN
SPECIFICATION

D10

BUSHFIRE PROTECTION

Amendment Record for this Specification Part

This Specification is Wollondilly Shire Council's edition of the AUS-SPEC generic specification part and includes Wollondilly Shire Council's primary amendments.

Details are provided below outlining the clauses amended from the Wollondilly Shire Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Perimeter road clearance	D10.04	A	DC	1/07/22
2	Fire hydrant location	D10.04	A	DC	1/07/22
3	Updated Fire Protection Zone to Asset Protection Zone	D10.05	M	DC	1/07/22
4	Updated Fuel Reduced Zone to Outer Protection Area	D10.06	M	DC	1/07/22
5	Updated Fuel Free Zone to Inner Protection Area	D10.07	M	DC	1/07/22
6	Crossfall and Clearance for Internal Access	D10.09	A	DC	1/07/22

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SPECIFICATION D10 : BUSHFIRE PROTECTION

GENERAL

D10.01 SCOPE

1. The work to be executed under this Specification consists of the design of bushfire protection facilities to protect life and property and bring a fire to a halt.
2. The specification contains procedures for the design of fire protection facilities. Designs shall be carried out to satisfy requirements of the Council and the guidelines published by the Department of Bushfire Services, May 1991. Consultation with Council's Fire Control Officer may be required.

D10.02 OBJECTIVES

1. This specification aims to outline the requirements that will minimise bushfire hazard in developments. The requirements are particularly pertinent to rural developments but should be an integral part of urbanised development as well. The concepts proposed need to be incorporated at an early stage of development design.

*Rural
Development
Urban
Development*

D10.03 REFERENCE AND SOURCE DOCUMENTS

(a) Council Specifications

Wollondilly Shire Council Construction Specification.

(b) NSW Government Legislation

Environment Planning and Assessment Act 1979 - Section 94

(c) NSW Government Department Publications

Department of Bushfire Services (May 1991)

- Planning for Bushfire Protection. A Guide for Land Use Planners, Fire Authorities, Developer and Home Owner.

Department of Land and Water Conservation (formerly Land Management)

- Soil Conservation Service 1983. Guidelines for Planning, Construction and Maintenance of Tracks.

Ministry of Urban Affairs (formerly Environment) and Planning

- "Planning Guidelines for Subdivisions in Bushfire Prone Areas" 1985.

NSW Department of Urban Affairs (formerly Environment) and Planning

- "Circular 74: Planning in Fire Prone Areas" 1984.

(d) Other

Board of Fire Commissioners

- "Hazard Reduction for the Protection of Buildings in Bushland areas" 1984.

Bush Fire Council of NSW

- "Everyone's Guide to Bushfire Control" 1984.
- "Everyone's Guide to Bushfire Prevention in Urban Bushland Areas" 1986.

- "Everyone's Guide to Wildfire Prevention in Rural Areas" 1986.
- Californian Department of Forestry
- "Fire Safety Guides for Residential Development in California" 1980.
- Insurance Council of Australia.
- "Bushfire Safety in Urban Fringe Areas."
- Luke, R.H. - "Before the Fires Start."
- NSW Rural Fire Service
- "Planning for Bush Fire Protection: A guide for councils, planners, fire authorities and developers" 2019

DESIGN CRITERIA

D10.04 GENERAL

1. Where a subdivision will abut unimproved timber in a bushfire prone area (as classified by Council), perimeter tracks are to be located immediately between the created allotment and the bushland within a minimum cleared width of 6m, and have a minimum formed width of 4m. Such roads shall be adequately drained to provide all weather access for fire fighting vehicles. Alternatively dedicated perimeter roads may be utilised. **Perimeter Tracks**

2. The perimeter track shall be contained within a reservation or easement which borders those allotments abutting the bushfire prone area. Reservation width requirements will vary depending on slope, orientation, vegetation and/or other features but shall be not less than 20m. Such a reserve shall serve as a basis for fire protection measures to be undertaken and will not be considered as part of the public reserve dedication applicable to the subdivision. **Reservation Width**

3. If dedicated perimeter roads are provided, there should be a minimum clear width of 8m from kerb to kerb. Parking and hydrants are to be outside of the carriageway. If kerb and gutter is provided on perimeter roads, roll kerb should be used on the hazard side. **Perimeter Roads**

4. Access is to be provided from the above described reservation from the local road system at regular intervals in a system of 'loops'. **Access**

5. For those subdivisions receiving reticulated water, fire hydrants shall be situated at appropriate intervals or near where potential fire hazard areas exist as determined by Council. Hydrants should be located outside of the carriageway and parking bays to minimise impact on traffic flow and access. **Fire Hydrants**

6. Council's Fire Control Officer shall be consulted for technical advice in relation to bushfire protection of subdivisions prior to engineering plan preparation. **Consultation**

7. Asset protection zones, access tracks and perimeter tracks shall be clearly indicated on the subdivision plan. Erosion control features and revegetation requirements shall also be indicated in the subdivision plan.

D10.05 ASSET PROTECTION ZONES

1. The provision of Asset Protection Zones (APZs) can only occur as part of the development of the subdivision pattern. Each individual allotment shall have adequate space for the main building (*usually a dwelling*), an area of open space (*front, back or side*) **Part of Development**

yard) and the APZ (which may include part of the yard area and/or neighbouring properties). Figure D10.1 illustrates a typical APZ.

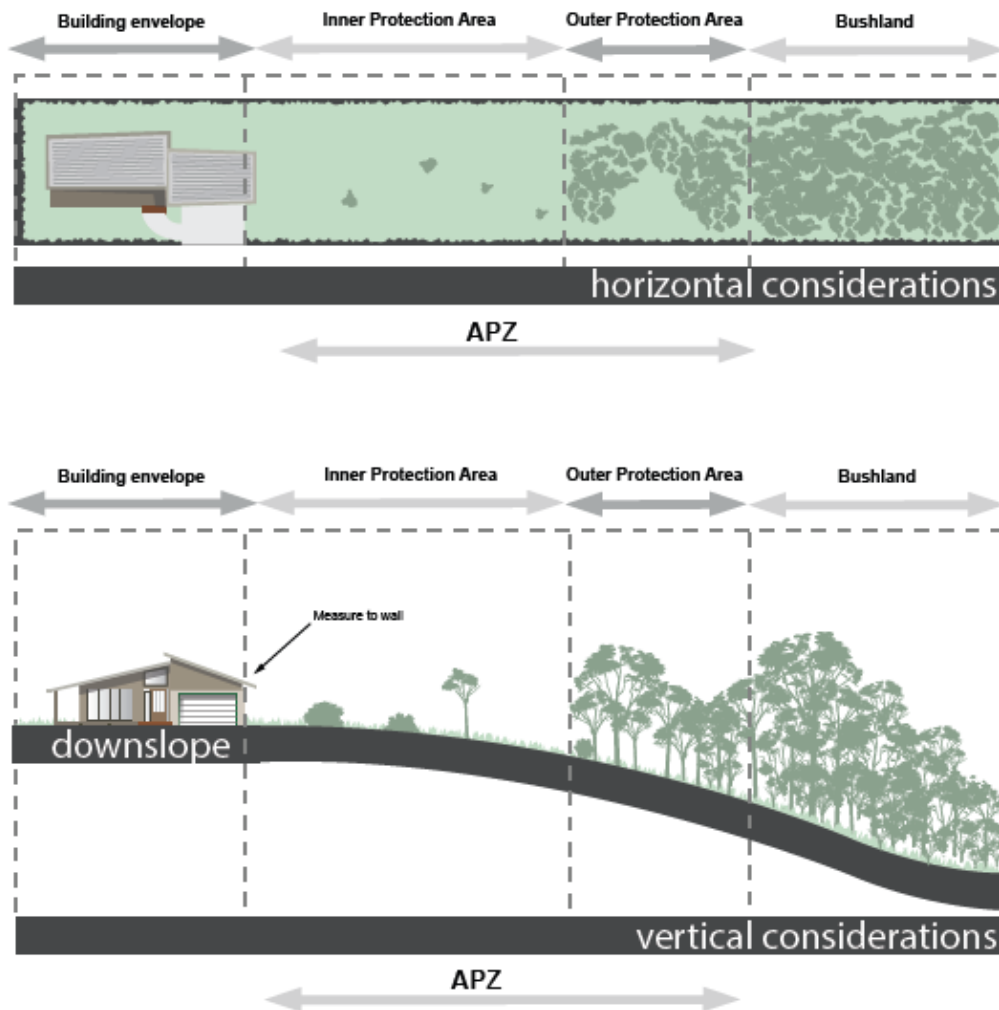


Figure D10.1 Asset Protection Zone

2. APZs shall be required for any development fronting a bush fire hazard area, whether a single dwelling, a group of isolated dwellings or an urban subdivision. They act as a buffer zone between the development and the fuel.

Buffer Zone

3. The primary purpose of APZs is to ensure that a progressive reduction of fuel occurs between the bush fire hazard and any combustible structures within the development.

Reduction of Fuel

4. Apart from its primary purpose the APZ serves a number of other important purposes, dependent upon local fire fighting policy. The APZ shall be designed to:

Other Purposes

- (a) maximise the separation distance between high intensity fire and any structure, thereby reducing the radiation and direct flame contact;
- (b) provide an area where embers can fall with minimal opportunity to create further fire outbreaks;
- (c) provide a safe access to a structure for fire fighters by reducing the heat level from the main fire;
- (d) provide a safe retreat for fire fighters; and
- (e) provide a clear control line from which to begin back burning or hazard reduction operations.

Safety requirements sometimes dictate that fires are fought from the property itself rather than along the perimeter track.

- | | |
|---|-----------------------------------|
| <p>5. The APZ incorporates two separate components:</p> <p>(a) Outer Protection Area (OPA) and</p> <p>(b) Inner Protection Area (IPA) incorporating:</p> <p style="margin-left: 20px;">(i) a perimeter road or reserve (which incorporates an access track); and</p> <p style="margin-left: 20px;">(ii) a set-back (currently defined by minimum lot depths), which is usually part of the allotment.</p> | <p>Separate Components</p> |
|---|-----------------------------------|

D10.06 OUTER PROTECTION AREA

- | | |
|--|--|
| <p>1. The OPA is located adjacent to the hazard:</p> <p>Originally it would have been part of the bush fire hazard but has become an area where the fuel loadings are reduced through thinning of vegetation, mechanical clearing, hazard reduction burning or location of suitable developments such as playing fields or car parks (provided it is wide enough).</p> | <p>Location</p> <p>Reduced Fuel Loadings</p> |
| <p>2. Fuel loadings within the OPA shall be kept to a level where the fire intensity expected will not impact on adjacent developments. In the absence of any policy to the contrary, 8 tonnes per hectare of total fuel is commonly used. Liaise with Council's Fire Control Officer.</p> | <p>Minimum Fuel Loadings</p> |
| <p>3. The OPA shall always be part of the development so that dedication of land or monetary contribution through Section 94 of the EP&A Act ensures that the cost of fire protection is met by the developer, not by the general community.</p> | <p>Part of the Development</p> |
| <p>4. For slopes greater than 20 degrees, the environmental consequences of ground clearing (erosion) may not be acceptable. Developments abutting such slopes shall avoid both the ridge and the slope.</p> | <p>Clearing Steep Slopes</p> |

D10.07 INNER PROTECTION AREA

- | | |
|--|--|
| <p>1. The Inner Protection Area is located adjacent to, or is part of, the development and comprises a perimeter road and a set-back.</p> <p>(a) Perimeter Road</p> <p style="margin-left: 20px;">(i) The perimeter road or access trail lies between the OPA and the boundary of the allotments.</p> <p style="margin-left: 20px;">(ii) The concept of a perimeter road requires that one side of the road has no fuel. Perimeter roads are not fire breaks in the same sense as used in firefighting operations. Their main purpose relates to reduction of radiation and provision of access. Without a fuel source on the other side, perimeter roads can however prove very effective fire breaks.</p> <p style="margin-left: 20px;">(iii) The form that the perimeter road or track takes will depend on local policy in regard to both road construction and fire fighting. In many instances, a perimeter reserve will be preferred due to cost. The reserve should be a minimum of 20m wide, with a 6m access track and passing bays about every 200m.</p> <p style="margin-left: 20px;">(iv) In designing for a perimeter road or track, the distance required may not seem very great. Given that the probability of fire jumping a fire break increases as the width decreases, then areas where the highest intensity fires are likely should have fire breaks of greatest width.</p> | <p>Location</p> <p>Concept</p> <p>Form</p> <p>Design</p> |
|--|--|

- (v) Perimeter roads can be less economic than roads which service two frontages unless some innovative designs are incorporated into the subdivision. Figure D10.2 illustrates perimeter roads and perimeter tracks.

Innovative Design

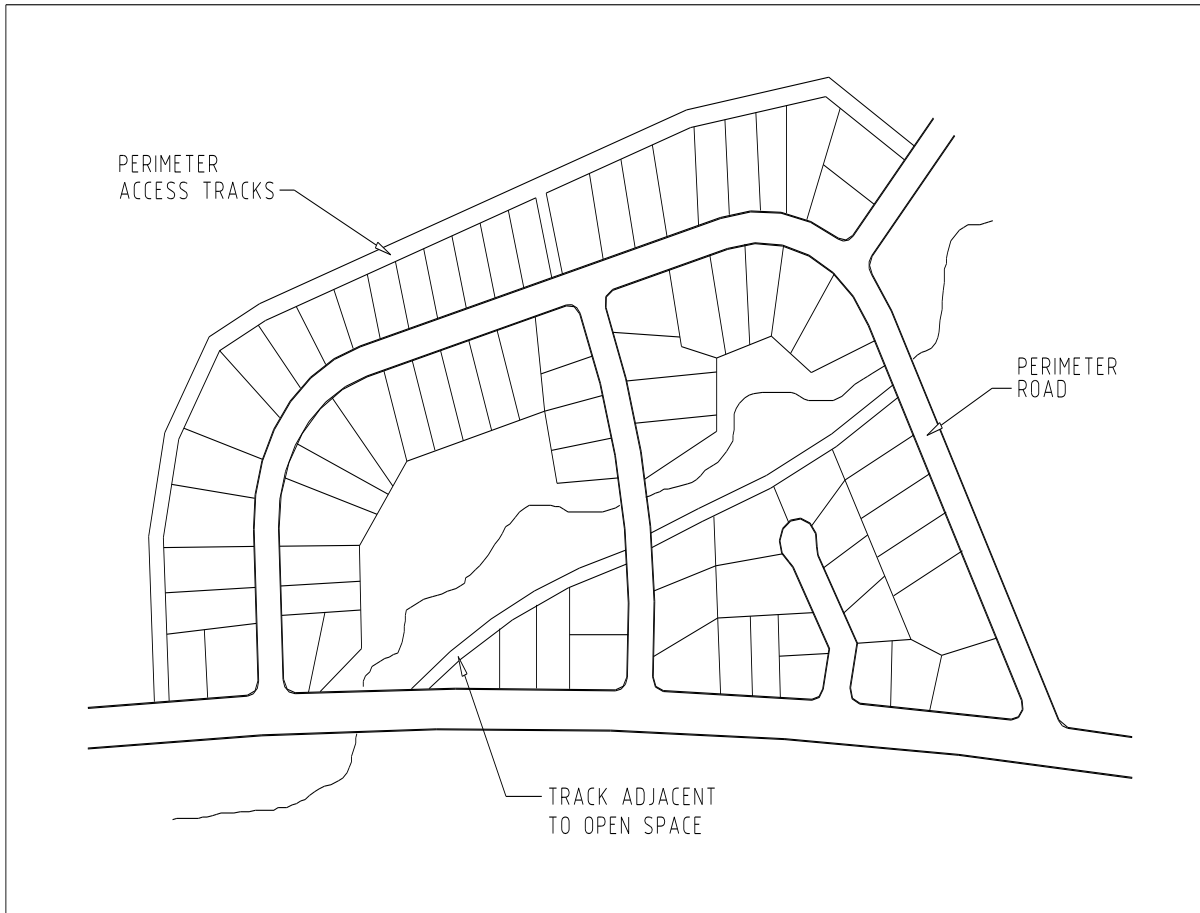


Figure D10.2 Perimeter Road Track

- (vi) Perimeter roads that do not require clearing or maintenance (compared to tracks), can be cheapest in the long term. Ultimately the decision between a road or track depends on the local council's subdivision and bush fire fighting policies.
- (vii) Tracks shall be constructed to Dept. of Land and Water Conservation's Soil Conservation Service (1983) guidelines.
- (b) Set-back
 - (i) Part of the allotment can be used as a section of the buffer by setting a minimum lot depth and rear setback. This can ensure that sufficient room (30-35m) is available to allow for erection of a dwelling that does not encroach upon the rear of the allotment.
 - (ii) The policy previously required a minimum of 40m lot depth in order to be consistent with the average minimum lot depth in bushland residential developments. Based on the requirement to maximise the distance between hazard and structures on reasonable grounds (*as developed above*) and a 30m wide building envelope which includes the surrounding yard, there is no justification for a 40m minimum lot depth in some instances.

No Clearance or Maintenance

Minimum Lot Depth

Previous Policy

D10.08 MODIFICATIONS TO OUTER AND INNER PROTECTION AREAS

1. Fire authorities would generally be reluctant to agree to modifications in the width of either the OPA or the IPA. If modifications were to be agreed, it would be after an examination of the particular cases rather than according to any formula.

Reluctance of Fire Authorities

2. Modifications would need to take account of adjacent or proposed development. Some difficulties arise where new development abuts existing development that is a fire hazard because of the nature of its usage (eg forests, parks etc). The general principle is that fire protection should be shared by both users which may require a certain level of negotiation outside the planning system.

Adjacent Development

3. Even without an extensive area of fuel outside the OPA, intense fires can develop if the OPA has not been hazard-reduced and if the fire begins as a line ignition from spotting embers.

4. Under adverse conditions fires moving up a slope may not be slowed by the presence of rocky outcrops and ledges, even though the continuity of the fuel bed may be broken.

D10.09 INTERNAL ACCESS FROM SUBDIVISION ROADS

1. The provision of adequate internal access is also controlled by subdivision design. Subdivision roads shall incorporate the following features:

Incorporated in Subdivision Design

- (a) width, vertical clearances of 4 m and any dips and crests which allow the two way movement of firefighting appliances;
- (b) construction standards of roads and any bridges which allow for the carrying of fully loaded fire appliances (28 tonnes or 8 tonnes per axle);
- (c) curves which have a minimum inner radius of 12m and are minimal in number;
- (d) maximum grades which do not exceed 15% (1:7) and preferably not more than 10% (1:10);
- (e) crossfall does not exceed 3 degrees;
- (f) clearly signposted roads;
- (g) dead end roads which do not exceed 200 metres in length;
- (h) dead ends which incorporate a minimum turning circle of 12.5m; and
- (i) a road network which connects regularly to any access tracks.

D10.10 STAGING WORKS

1. When considering the staging of development, planners shall provide for initial development to occur on the hazard perimeter of the development. A line of dwellings will tend to minimise the threat to the entire subdivision by limiting the hazard interface.

Initial Development on Hazard Perimeter

2. Scattered developments on the other hand, will allow a continuous network of fuel to threaten individual buildings until development is substantially underway.

Scattered Developments

3. For similar reasons, new developments should be 'tacked' onto old developments to minimise the hazard perimeter.

Minimise Hazard Perimeter

4. It is important that much of the bush fire protection is incorporated into the design of the development, rather than into individual allotments.

***Incorporated
in Subdivision
Design***

STANDARD DRAWINGS

D10.100 LIST OF DRAWINGS

***List of
Drawings***

1. DRAWING NUMBER DRAWING DESCRIPTION

WSC.D10.1 Deleted

DESIGN
SPECIFICATION

D13

**ACCESS & OFF-STREET
PARKING**

Amendment Record for this Specification Part

This Specification is Council's edition of the AUS-SPEC generic specification part and includes Council's primary amendments.

Details are provided below outlining the clauses amended from the Council edition of this AUS-SPEC Specification Part. The clause numbering and context of each clause are preserved. New text is shown underlined and deleted text shown struck through (eg. or as 'DELETED'). New clauses are added towards the rear of the specification part as special requirements clauses. Project specific additional script is shown in the specification as italic font.

The amendment code indicated below is 'A' for additional script 'M' for modification to script and 'O' for omission of script. An additional code 'P' is included when the amendment is project specific.

Amendment Sequence No.	Key Topic addressed in amendment	Clause No.	Amendment Code	Author Initials	Amendment Date
1	Minimum horizontal clearance	D13.06	A	DC	1/07/22
2	Footpath at Property Entrances	D13.10	A	DC	1/07/22
3	Design of Parking Spaces	D13.14	M	DR	1/07/22
4	Access Handle Width	D13.15	A	DR	1/07/22
5	Materials for Internal Driveways	D13.18	M	DC	1/07/22
6	Removed Segmental Pavers	D13.19	O	DC	1/07/22
7	Standard Drawings	D13.100	M	DC	1/07/22

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SPECIFICATION D13 : ACCESS & OFF-STREET PARKING**GENERAL****D13.01 SCOPE**

- 1 This design & construction specification sets out the minimum requirements for:
- property entrances into allotments
 - access handles
 - internal driveways, and
 - parking spaces.

D13.02 OBJECTIVES

- 1 The objective is to provide for suitable vehicular access from the road to carparking and service facilities on the property.
- 2 The objective in designing access driveways to developments are to:
- provide safe and convenient all weather vehicle access to the development
 - maintain vehicle and pedestrian safety standards
 - maintain traffic flow standards
 - protect the footway.
- 3 The objective of designing internal roads is that they allow for safe and convenient all weather vehicle access to and from all parking spaces and loading bays on the property. They are to be constructed of such materials and in such a manner as to perform adequately and require minimal maintenance under the anticipated traffic loading for the design life adopted.
- 4 Carparking spaces must be of an adequate length and width.

D13.03 REFERENCE AND SOURCE DOCUMENTS**(a) Council Specifications**

DCP 7 Off-street Car Parking

(b) Australian Standards

AS 1428.1 – 1993 – General Requirements for Access – Buildings

AS 2890 – Parking Facilities

AS/NZS 3661.1- 1993 – Slip Resistance of Pedestrian Surfaces – Requirements

AS3727 – 1993 - Guide to Residential Pavements

(c) State Authorities

Roads and Traffic Authority NSW – Guide to Traffic Generating Developments

(d) Other

Austrroads - Guide to Traffic Engineering Practice, Part 5 - Intersections at Grade

PROPERTY ENTRANCES

D13.04 PROPERTY ENTRANCE WIDTHS

1 Excessively wide property entrances can compromise pedestrian safety and detract from the streetscape. The width of any access driveway to a residential property with less than 10 parking spaces, from a road with kerb and gutter and a formed footway is to be a minimum of 3.0 metres and a maximum of 4.0 metres. Wheel strips are not suitable.

**Residential
Property
Entrances
Widths**

2 Property entrances with a maximum width of six (6) metres will be permitted to facilitate access to two adjacent garages or carports if the distance between the parking space and the street frontage is less than 5.0 metres.

3 Property entrances into non-residential properties and residential properties with 10 or more parking spaces shall be designed in accordance with tables D13.1 & 2

**Non-
Residential**

Type	Entry Width (m)	Exit Width (m)	Minimum Separation of Driveway (m)
1	3 – 6	Combined	NA
2	6 – 9	Combined	NA
3	6	4 – 6	1 – 3
4	6 – 8	6 – 8	1 – 3
5	Direct feed from a controlled intersection via a dedicated roadway		
6	8 - 10	8 – 10	3
7	10 - 12	10 - 12	3

Table D13.1 – Recommended Driveway Types

Road Frontage	Number of Carparking Spaces Served by the Driveway					
	Less than 25	25 - 100	101 - 300	301 - 600	More than 600	Heavy Vehicles
Major	1 – 2	2 - 3	3 - 4	4	5	7
Minor	1	1 - 2	2 - 3	3 - 4	4	6

Table D13.2 – Selection of a Driveway type based on parking spaces

D13.05 LAYOUT

1 Residential developments will be permitted a maximum of two property entrances to any public road frontage provided;

- the minimum separation between property entrances is 3.0 metre and
- the sum of the widths of all property entrances to any street frontage does not represent more than 30% of the total width of the property frontage to that street.

2 Minimum separations prevent two property entrances being used as one. Limiting property entrance widths allows for adequate pedestrian refuge and provides opportunity to present a more desirable streetscape. The minimum separation between adjoining property footway crossings is 2.0 metre (providing at least 1.0 metre between vehicle layback crossings). Where limited frontage prevents such separation, an absolute minimum of 1.5 metre may be approved by Council's Infrastructure Planning Engineers.

**Minimum
footway
crossing
separation**

3 Despite the 30% criteria outlined above, duplex developments may be permitted to have two property entrances where the location of the garages on the property do not permit the use of a shared crossover.

Duplexes

4 Generally all property entrances are to be constructed perpendicular to the kerblines.

Crossing Angle

5 In some instances to reduce disturbance to traffic flow along a major traffic route, an angled entrance may be permissible subject to approval by Council's Traffic Engineer.

6 It may be necessary to provide Auxiliary Lanes and/or Right Turn Bays in order to limit disruption to traffic along high speed or high volume roads. The design of auxiliary lanes must give particular attention to pedestrian safety. Refer to Austroads publication *Guide to Traffic Engineering Practice, Part 5 – Intersections at Grade* for design details.

**Auxiliary
Lanes &
Turning Bays**

7 In certain circumstances, the Traffic Committee may restrict property access to left in - left out movements only. It will be necessary to erect appropriate signs and may be necessary to construct a median island within the road reserve to ensure compliance.

**Left In - Left
Out**

8 If separate crossings are provided for entering and exiting traffic they shall be sign posted with "in" or "entrance" or "out" or "exit" as appropriate.

**In-Out Sign
Posts**

9.

D13.06 PROPERTY ENTRANCES LOCATIONS

1 : A property entrance shall be located adjacent to the addressed road frontage. Where a lot has two road frontages, a property entrance on the secondary frontage will generally only be permitted in the following circumstances:

**Frontage
Restrictions**

-
- Garages and/or carports fronting a secondary road frontage must be set back to a distance equal to or greater than the addressed frontage setback requirements.
- On urban residential corner lots, garages and/or carports may be accessed from the secondary frontage, only when the secondary frontage is of equal or lesser road hierarchy/classification than the addressed frontage.
- The vehicular access is not the primary access for emergency services.
- Where it can be demonstrated that access will not impact on road safety or levels of service.

2 The location of driveways in the vicinity of intersections is not permitted:

- Within 25m of a signalised intersection
- Within 9m at other intersections.

These distances are measured from the face of kerb of the perpendicular street. The desirable restrictions set out above will be enforced unless it is demonstrated to Council's satisfaction that extenuating circumstances exist.

3 Property entrances should be located to ensure adequate sight distances are provided to traffic and pedestrians. Minimum traffic sight distances are outlined in the desirable sight distance (DSD) column of the table D13.3.

Sight Distances

4 At the sole discretion of Council's Traffic Engineer sight distances as low as those given in the approach sight distance (ASD) column may be approved provided no reasonable alternative exists for improving sight distances. New lots in proposed subdivision developments will not be approved if it is not possible to provide a vehicle access to that lot that will satisfy the desirable sight distance minimums of table D13.3. Sight distance to pedestrians shall be met by providing clear sight lines in the areas indicated by figure D13.2 below.

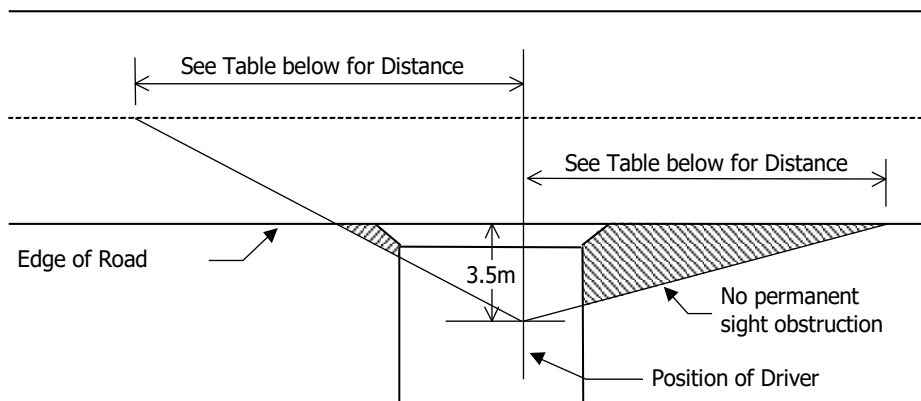


Figure D13.1 Traffic Sight Distance

Urban Roads		
Approach Speed of through road (km/hr)	ASD (m) (1.5 s reaction time)	DSD (m)
50	45	80
60	55	105
70	70	130
80	95	165
Rural Roads		
Approach Speed of through road (km/hr)	ASD (m) (1.2 s reaction time)	DSD (m)
80	115	175
90	140	210
100	170	250

NOTE: These figures do not include cumulative specific allowance for gradients, variations in road surface, quality of street lighting and similar factors all of which, from a safety point of view, must be taken into consideration.

Table D13.3

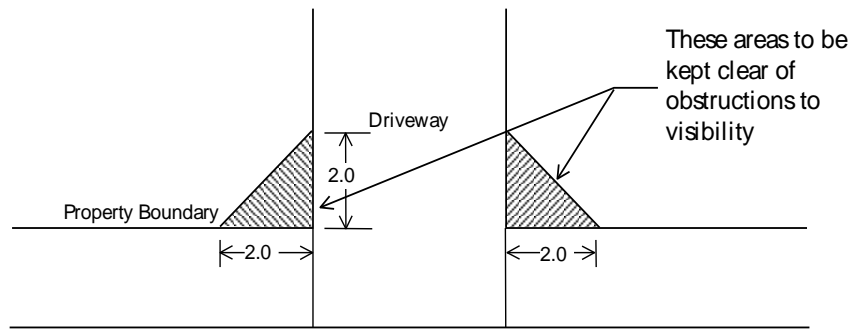


Figure D13.2 Minimum Sight Lines for Pedestrian Safety

5 Consideration must be given to the potential for obstructions such as trees, earth mounds, bus shelters and the like to adversely affect sight lines.

Obstructions to Sight Lines

6 Where an existing bus shelter adversely impacts on the sight lines of vehicles using a proposed property entrance, Council may give consideration to moving the bus shelter to another location in front of the property, or constructing a new bus shelter in another location. All costs associated with such work will be borne by the applicant.

Moving a Bus Shelter

7 Access driveways shall be located clear of existing kerb inlet pits. Removing or reducing the length of a pit lintel is not acceptable.

Kerb Inlet Pits

8 Provided the pit is not a sag pit, Council may give consideration to moving a kerb inlet pit and lintel to another location in front of the property, in order to facilitate construction of the footway crossover. All costs associated with such work will be borne by the applicant.

Moving a Kerb Inlet Pit

9 Where a driveway entrance is to be gated, the gate needs to be setback such that there is sufficient space for a vehicle to stop clear of the carriageway while the gate is being opened. For urban areas gates shall be setback a minimum 6.0 metres from the kerb and gutter alignment or edge of carriageway. For Rural/Primary Production, Commercial or Industrial developments the gate setback shall be made suitable for the expected size of vehicle to require access to the property. Generally, Rural/Primary Production, Commercial and Industrial area gate setback will be a minimum 15.0 metres from the carriageway for 12.5 metre Single Unit Truck access.

10 Unless specified by another asset authority, the following minimum separation shall be provided.

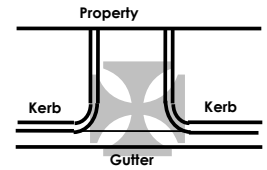
Property Separation to Road Assets

Asset	Minimum Horizontal Clearance
Light poles/power poles	1.0 m
Street trees	1.5 m (for small or juvenile) 3.0 m (for large or mature)
Pedestrian ramp	1.5 m
Other driveways	2.0 m

Note: Separation less than shown on the above table may be considered by Council in special circumstances.

D13.07 GUTTER CROSSINGS

1 Property entrances from roads with barrier kerb should have a gutter crossing (layback) constructed in the kerb line rather than returning the kerb to the property boundary. Details for gutter crossings (laybacks) are provided in the Appendix.



2 Kerb returns may be acceptable where:

- The access is to a heavily trafficked road, and the development generates a large amount of traffic, or the driveway is used by heavy vehicles, or
- The access is to a road with high traffic speeds.

Approval for the use of kerb returns shall be at the discretion of Council's Traffic Engineer.

3 If kerb returns are permitted/required kerb ramps will need to be provided to facilitate pram and wheelchair movements. See Drawing No. WSC.D1.17 in the Appendix for details.

Kerb Ramps

4 In kerbed streets with a steep crossfall, bridge crossings over gutters may be approved for use as a last resort to prevent vehicles scraping.

5 In roads where it is necessary to cross a table drain to gain access to the property either a piped crossing or dish crossing will need to be provided depending on the depth of the table drain. See Drawing No. WSC.D1.16 in the Appendix for details.

6 Dish crossings are to be limited to locations where the gradient between the edge of the road pavement and the existing invert of the table drain does not exceed 4%. They are to be boxed below the invert level of the table drain so that the top of the dish crossing matches the existing invert level of the dish drain both on its upstream and downstream ends. A bitumen seal must be provided between the edge of the road pavement and the edge of the concrete dish crossing.

7 The location and level of the piped crossing must be approved by Council and will need to ensure:

- Rainwater will not pond in the table drain.
- The road shoulder is not narrowed or its levels modified.
- As much as possible, it is located outside the roadside clear zone. Headwalls located within the clear zone may need to be tapered for safety.
- Vehicles will not scrape when entering or leaving the property.
- There is no adverse impact on pedestrian movements along the footway.
- There is no adverse impact on existing trees, other crossings, service utilities and the like.

8 To limit the chance of blockage, the minimum size of a piped culvert is to be 375mm diameter. A larger culvert may be required to ensure adequate capacity to convey stormwater runoff. As a minimum, the capacity of the piped culvert should be equal to the lesser of either:

- The anticipated runoff from a 20% AEP, or
- The existing capacity of the table drain.

9 All regrading of the table drain upstream and downstream of the piped culvert that may be necessary to ensure the suitable conveyance of rainwater runoff along the table-drain, will be carried out at the developer's expense.

D13.08 LEVELS OF FOOTPATH CROSSING

1 The levels of the property entrance should be designed to:

- Ensure vehicle scraping does not occur
- Ensure maximum gradients are not exceeded
- Limit regrading of the footpath area
- Minimise disruption to pedestrians using the footpath area
- Preserve existing trees
- Ensure appropriate cover over existing underground utilities
- Ensure compatibility with existing or possible future plans for realignment of the road.

2 Typically, the property entrance should have a 4% gradient from the property alignment to the top of kerb. In roads where there is no kerb, the property entrance should have a 4% gradient from the property alignment to the edge of road shoulder. Where this is not practical, a design detailing the levels of the proposed property entrance should be prepared and submitted to Council for approval.

3 Where pedestrians use or are likely to use the footpath area, the levels of the access driveway must provide for pedestrians. In this regard, the section of driveway between 0.9m and 2.1m from the property alignment is to have a 4% gradient towards the kerblines. Where there is existing footpath paving the location and width of the footpath over the driveway shall match the existing. Council will give consideration to permitting the 1.5 metre wide footpath section to be located at the back of the layback in situations where levels at the property boundary are significantly above or below the level at the kerblines.

4 If the approved levels of the property entrance differ from the existing footway levels, the surrounding footway area must be regraded to satisfactorily marry with the new crossing. The minimum extent of footway which must be regraded is determined using the design constraints outlined below:

- The maximum change of grade along the footway is to be 1 in 10 with a minimum segment length of 4.0 metres;
- The maximum longitudinal grade of the footway is to be 1 in 6

5 If access to adjoining private properties is affected by the footway regrading, all work necessary shall be done within those properties to ensure satisfactory pedestrian and vehicular access is restored.

6 It will be necessary to obtain written consent from the adjoining property owner(s) that they will permit the applicant's contractors to enter their property and undertake all work necessary to ensure vehicles and pedestrians have satisfactory access to the property following regrading of the footway. This letter of consent must be submitted to the principal certifying authority prior to issuing of the construction certificate for the building works.

Altering Public Footway Levels

Regrading within Adjoining Private Properties

7 All mains, services, poles, footpath paving etc that require alteration shall be at the applicants expense and to the satisfaction of Council and the authority concerned.

8 Where the alteration of a house service is required, it is to be carried out by a suitably experienced tradesperson. Twenty-four (24) hours notice shall be given to the affected property owner before their service is affected.

Alteration of House Services

9 In the case of public utility mains, if a main must be raised, lowered or relocated, the applicant shall liase with the relevant Authority to organise the alteration and undertake all work to the satisfaction of that Authority.

Alteration of Mains

10 The applicant shall arrange with the relevant authority for the alteration of all surface fittings of all services which are affected by the new finished surface levels.

Surface Fittings

11 If the ground level of the property adjacent the footpath is above or below the finished level of the footway then adequate measures must be taken to support the land by constructing either earth batters or retaining structures. These are to be fully contained within the property and are not to encroach onto the public footway.

Retaining Private Properties

12 Where retaining of an adjoining property is necessary as a consequence of regrading the footway, written permission from the affected property owner(s) to enter their property and undertake such work must be submitted to the principal certifying authority prior to issuing of the construction certificate for the building works.

Regrading Adjoining Properties

D13.09 SUITABLE MATERIALS FOR USE IN PROPERTY ENTRANCES

1 Gutter Crossings, dish crossings and piped culvert crossings shall be constructed in accordance with the detail drawings shown in the Appendix.

2 Footpath Crossings in roads with kerb and gutter and in roads with a formed footpath area suitable for use by pedestrians are to be constructed of:

- plain concrete with a 28 day compressive strength of 25Mpa, or
- coloured or patterned concrete with a 28 day compressive strength of 25Mpa, or
- concrete pavers

3 The applicant is to be aware that any future restoration of the footway crossing carried out by Council or another service authority will be in plain concrete. The extent of restoration will be limited to the area damaged. Generally it will not extend to replacing the entire footway crossing slab.

Future Restorations

4 In roads without kerb and gutter or a formed pedestrian footway, footway crossovers may be constructed of crushed sandstone or approved road base material and be sealed with a spray bitumen seal or asphalt surface. Access to commercial and industrial premises and accesses that service more than one dwelling will need to be sealed. .

Where it is intended to use a concrete crossover, the front lip of the concrete shall be located a minimum 2.0 metres clear of the carriageway. A bitumen seal or asphalt surface shall be constructed to the carriageway.

D13.10 PROPERTY ENTRANCE PAVEMENT DETAILS

1 Concrete slabs shall be constructed in accordance with the following thicknesses:

Thickness

Up to two dwellings	125mm thick, + 1 layer of F72 fabric
---------------------	--------------------------------------

- | | | |
|---|---|----------------------------|
| <p>More than two dwellings, Commercial,
Light Industrial</p> <p>Major Commercial / Heavy Industrial</p> | <p>150mm thick + 1 layer of F72 fabric</p> <p>200mm thick + 2 layers F72 fabric</p> | |
| <p>2 Reinforcing shall have approximately 40mm top cover and should be supported during construction by bar chairs at 1 metre centres. The reinforcement should not be continuous through a control joint.</p> | | Reinforcement |
| <p>3 A 150mm thick compacted, granular sub-base shall be provided for all commercial footway crossings. A 50mm thick compacted, granular sub-base shall be provided under all other concrete footway crossings.</p> | | Sub-Base |
| <p>4 Mastic joints 5mm thick are to be provided at the property boundary and at the rear of the gutter crossing (layback). Dummy joints shall be provided at either side of the footway where applicable.</p> | | Construction Joints |
| <p>5 Concrete crossovers should usually have a broom finish unless it has a gradient steeper than 1 (vertical) to 5 (horizontal) when it should be finished with a wooden float. The finish is to be a uniform, non-slip surface. All edges are to be rounded with a 5mm edging tool.</p> | | Finish Quality |
| <p>6 Any damaged, defaced or otherwise unsatisfactory section shall be removed and replaced.</p> | | Poor Finish |
| <p>7 All footway crossings should have slip resistance appropriate for the pavement slopes as required by AS/NZS 3661.1. The relative level of adjacent pavers should not be greater than 5mm, and gaps between pavers or in patterned concrete slabs, no greater than 3 mm. The finish is not to constitute a hazard to pedestrians.</p> | | Pedestrians |
| <p>8 Sandstone and Road base access driveways shall have a minimum thickness of 200mm. The seal shall be asphaltic concrete or a two coat 14/7 spray seal and shall smoothly match into the existing public road pavement.</p> | | |
| <p>9 Concrete crossovers shall generally be of plain concrete colour from the back of kerb to the property boundary or other location as determined by Council Engineers.</p> | | |
| <p>10 Where concrete footpaths exist, the paths shall be retained or replaced to match existing levels. Dummy joints shall be placed along the footpath alignment to outline the location of the path. Footpaths shall be replaced with plain concrete and finished as per the footpath design specification.</p> | | |

D13.11 USING AN EXSITING PROPERTY ENTRANCE

- 1 Existing property entrance may only be used to service new property developments when:
- the existing crossing is in the correct location, at the correct level and in good condition, and
 - the existing crossing is not a bridge crossing.
- 2 Otherwise, the crossing is to be removed and a new crossing constructed.

D13.12 DISUSED ACCESS CROSSINGS

- 1 Footway crossings slabs, or parts of footway crossings slabs, that become redundant are to be removed and the footway area restored. Disused gutter crossings are to be removed and the kerb reinstated.
- 2 Any existing unused gutter crossings and footway crossing slab will also need to be removed, irrespective of the fact that it may have not become redundant as a consequence of the current application.
- 3 Details for kerb and gutter construction are given on plan WSC.D1.12 in the Appendix

INTERNAL DRIVEWAYS, MANOEUVRING AREAS AND PARKING SPACES

D13.13 GENERAL

- 1 The design of all parking spaces, circulation roads and manoeuvring areas on the property must conform to the minimum requirements outlined below and the design criteria in AS 2890.1-1993 Parking Facilities, Part1 Off-street Parking. In so far as any inconsistency exists between criteria outlined below and the Australian Standards, the criteria in this document shall apply.
- 2 An internal manoeuvring area shall be provided to allow vehicles to turn and exit the property in a forward direction in the following situations:
 - a. Residential developments where vehicles are expected to have to reverse more than 15.0m to the road carriageway,
 - b. Residential developments where driveway grades or limited sight distance would make reversing vehicles a high risk manoeuvre.
 - c. Commercial and Industrial developments and carparks.
 - d. Where heavy vehicles are expected to require regular access to the property, including rural, commercial and industrial properties.

Manoeuvring Areas

D13.14 DESIGN OF PARKING SPACES

- 1 The dimensions of spaces shall be as per AS2890 in accordance with the relevant user class. Minimum depth may also apply as per the DCP.

User Class

Development Type	User Class		Disability Access
	Visitor	Staff*	
Childcare	3A	1-1A	4
Shopping Centre Retail	3A	1	4
Residential and Units	1	-	4
Medical Centre	3-3A	1	4

* Maximum number of parking spaces allocated to staff will be 50%.

- 2 The minimum clear width of an enclosed single vehicle garage shall be 3.0m. Garage doorways shall have a minimum width of 2.4m. A wider doorway may be required if there is not sufficient manoeuvring space in front of the garage

Garage Parking

to enable a straight entry, and to allow for vehicle clearance. The minimum parking area in a garage shall be 2.6x5.4m.

- | | | |
|---|---|-------------------------|
| 3 | Where the parking is provided as an undercover space, Council may permit a reduction of the clear width of parking spaces in accordance with AS2890.1 Figure 5.1 if columns are setback from the front of the space. | Columns |
| 4 | Provision shall be made for the sweep of the front of the vehicle where a parking space is perpendicular to the access driveway. Refer to AS2890.1 2.4.2 (c). | Blind Aisles |
| 5 | Refer to AS 2890.1 Figure 2.2 for dimensions of angled parking, in accordance with the above user class. | Angled Parking |
| 6 | Refer to AS2890.1 Figure 2.5 for dimensions of parallel parking, in accordance with the above user class. | Parallel Parking |
| 7 | Off-street parking may include a component of stacked parking spaces where it can be demonstrated that the following is achieved: <ul style="list-style-type: none"> a. Only used for staff parking or residential parking for the same unit or lot. b. Only allocated for a maximum 50% of parking spaces required for staff. c. Separate manoeuvring areas for two cars clear of public roads, footpaths driveway entries. | Stacked Parking |

D13.15 INTERNAL ACCESS DRIVEWAY WIDTHS

- | | | |
|----|--|-----------------------------------|
| 1. | Provision must be available within the property to enable vehicles (85 percentile vehicle) to enter the designated parking space in a single turning movement and leave the space in no more than two turning movements. Turning templates are supplied in the appendix. A clearance of 300mm should be added to both sides of the turning path. | |
| 2. | Provision must be made for vehicles to enter and leave the site in a forward direction. This standard does not apply to driveways from single domestic dwellings onto access, local or collector roads. | Forward Direction |
| 3. | Internal driveway access shall provide for a clear zone along the full length of the driveway and any associated turning area. The clear zone is required to provide adequate clearance to buildings, fences, eaves, and vegetation (other than the required access handle landscape). Horizontal clear zone should extend a minimum 500mm past the edge of the formed driveway. Vertical clear zone should extend a minimum 500mm above the expected 95 th % vehicle with a minimum overall vertical clear zone of 2.5 metre from the upper surface of the access driveway pavement. For example, a 3.0-metre-wide residential driveway access should be provided with a 4.0-metre-wide by 2.5m high clear zone. | Driveway access clear zone |
| 4. | The minimum widths for internal driveways and accessways shall be as outlined in table D13.5 below: | |

Development Type	Minimum Pavement Width ⁽¹⁾
Urban and Rural Residential	

Single Domestic Dwelling	3.0 m
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Access handles ≤ 3 allotments > 3 allotments	4.0 m
Accessways to Multiple lots ≤ 7 dwellings > 7 dwellings	4.0 m ⁽²⁾ See Category B & C Cul-de-sac requirements D1 – GEOMETRIC ROAD REQUIREMENTS
Driveways in Medium Density Developments ≤ 10 parking spaces > 10 parking spaces	4.0m ⁽³⁾ 5.5 m
Rural	
Single Domestic Dwelling	3.0 m with min 0.5m shoulders with 15 m reservation for the road
Accessways to Multiple lots ≤ 5 dwellings > 5 & less than 15 dwellings >15 dwellings	4.0 m pavement with min. 0.5 m shoulders ⁽⁴⁾ with 20 m reservation for the road 4.0 m pavement with min 1.5 m shoulders ⁽⁴⁾ with 20 m reservation for the road See Category G2 Cul-de-sac requirements D1 – GEOMETRIC ROAD REQUIREMENTS, provide minimum 20 m reservation for the road
Commercial / Industrial	
All	3.0 m one way 6.0 m two way
<p>NOTES</p> <p>1 If there is a kerb or barrier higher than 150mm and closer than 300mm from the edge of the roadway, the roadway shall be widened to provide a minimum of 300mm clearance to the obstruction.</p> <p>2 Maximum length is 100m. A passing bay is required if length is greater than 80m. Greater than 100m length, minimum width = 5.5 m.</p> <p>3 Provision for vehicle passing at least every 30m by way of a passing bay that will provide a minimum carriageway width of 5.5m for a minimum length of 7.0m</p> <p>4 Provision for vehicle passing at least every 100m by way of a passing bay that will provide a minimum carriageway width of 5.5m for a minimum length of 7.0m</p>	

Table D13.5

5 Refer to the relevant Development Control Plan for details on minimum width of access handles in different zones.

D13.16 RURAL RIGHT OF CARRIAGEWAY WIDTHS

- 1 The minimum width for ROC are: **ROC Width.**
- 15.0 metres where located adjacent to an adjoining property with separate ownership. This width is required to provide adequate space for access construction & service provision without adversely affecting the adjoining property.
 - 10.0 metres where located clear of any adjoining property.

D13.17 GRADIENTS

- 1 The desirable maximum grade for parking bays shall be: **Parking Space Grades**
- measured parallel with the angle of parking - 1 in 20 (5%); and
 - measured at 90° to the angle of parking - 1 in 20 (5%).
- 2 The minimum driveway grade shall be 1 in 200 (0.5%). **Minimum Driveway Grade**
- 3 The maximum grade for residential driveways or accessways shall be designed in accordance with AS 2890.1. **Maximum Driveway Grade**
- 4 The maximum grade of a driveway for commercial use shall be 1 in 6 (16.67%)
- 5 Driveway grades on curves shall be measured along the inside edge of the carriageway.
- 6 Vehicle scraping may occur when changes of grade exceed 1 in 8 (12.5%). Where there is a potential for vehicle scraping, transition sections, with a minimum length of 2.0 metres, are to be provided. **Changes of Grade**
- 7 The maximum crossfall on an internal roadway shall be 5%. **Crossfalls**
- 8 Buildings with high public usage and aged and disabled housing developments must provide pedestrian access in accordance with the requirements of AS 1428.1 – 2001 **People with limited mobility**
- 9 Rural Right of Carriageway. **ROC Grades**
- Table drains at grades greater than 10% shall be concrete lined and gutter.
 - Table drains at grades lesser than 10% shall be turfed.
 - Road surface on grade more than 16% shall be asphaltic concrete seal with 30mm AC10 on single coat seal of 10mm aggregates.

D13.18 SUITABLE MATERIALS FOR INTERNAL DRIVEWAYS AND ACCESSWAYS

- 1 Acceptable pavement materials are listed in table D13.6 below.

Development Type	Acceptable Pavement Types
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Urban Residential	Concrete Concrete Permeable Pavement
Rural Residential	Concrete Concrete Permeable Pavement Flexible pavement with Asphalt Flexible pavement with Spray Seal Flexible pavement unsealed*
Rural	Concrete Concrete Permeable Pavement Flexible pavement with Asphalt Flexible pavement with Spray Seal Flexible pavement unsealed*
Commercial/Industrial	Concrete Concrete Permeable Pavement Flexible pavement with Asphalt Flexible pavement unsealed*
* Council may consider an all-weather unsealed driveway where it can be demonstrated that there is a low risk dust and the tracking of mud and other debris onto the adjoining roadway	

Table D13.6

2 Unsealed pavements may be considered for existing rural dwellings or secondary dwellings in rural residential areas. Council may also consider unsealed pavements in small commercial developments where it can be demonstrated that development traffic will have a low risk of dust generation. Unsealed pavements should be designed in accordance with D13.19 (d).

Unsealed Pavements

3 In some areas, Council may require the use of a coloured or patterned concrete driveway to provide a desired streetscape appearance.

4 Segmental pavers are not permitted in footpath areas.

Pavers Not Permitted

D13.19 INTERNAL DRIVEWAY AND ACCESSWAY PAVEMENT DETAILS

1 Internal pavements for residential developments consisting of single dwellings or multiple dwellings shall be in accordance AS 3727-1993 "Guide to Residential Pavement". Extracts from this standard are provided below. Pavements that will carry heavy vehicles or significant traffic volumes shall be designed in accordance with the AustRoads "Pavement Design" manual (AustRoads 1992) or the Clay Brick & Paver Institute publication "Specifying and Laying Clay Pavers".

Design Manuals

(a) Concrete Pavements

2 Typical slab thickness, concrete grade, joint spacing and reinforcement should be in accordance with Table D13.7 below

Traffic	Min Slab Thickness	Min Concrete Grade	Alternative 1		Alternative 2	
			Max. Control joint	Min Reo Fabric	Max. Control joint	Min Reo Fabric

			Spacing		Spacing			
Light Traffic – Use by no more than two Dwellings	125	N25	3	SL72	5	SL82		
Medium Residential Traffic Light/Industrial Commercial	150	N25	4	SL72	6	SL82		
Heavy Industrial/Commercial	See AustRoads "Pavement Design" Manual							

Note: Slab thickness is measured from the underside of the slab to the bottom of any top surface patterning.

Table D13.7

3 Reinforcing shall have approximately 40 mm top cover and should be supported during construction by bar chairs at 1 metre centres. The reinforcement should not be continuous through a control joint. Where the slab surrounds another structure such as a drainage pit, trimming reinforcement should be used. Trimming reinforcement should be not less than one Y12 bar of minimum length 600mm.

Reinforcement

4 Control joints shall have spacings no greater than shown in the table above. They shall be constructed by formwork between concrete pours, or creating a plane of weakness to a depth of one third to one quarter of the pavement thickness. Mastic isolation joints should be provided where a pavement adjoins a building or other rigid structure such as a drainage pit.

Joints

(b) DELETED

(c) Permeable Pavements

- 9 Permeable pavement layers shall be acceptable provided they:
- Are designed and installed as per the manufacturer’s recommendations
 - Allow infiltration of rainfall as per WSUD principles.

(d) Flexible Pavements

10 In rural or rural residential areas the minimum design requirements of flexible pavement driveways and accessways shall be:

Wearing Course	two coat 14/10 spray seal or 30 mm AC10
Base Course	100mm DGB 20 where wearing course is AC or 100mm of 40mm crushed sandstone if not AC seal
Sub-base	100mm of 40 mm crushed sandstone
Compacted Sub grade	

11 An asphaltic pavement may be constructed as full depth asphalt pavement or consist of a combination of sub-base, base course and asphalt surfacing. Typical pavement specifications shall be in accordance with table D13.9 below:

Flexible Pavements

Traffic	Asphalt and Base course	Full Depth Asphalt
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Light Traffic - Use by no more than two Dwellings	30mm AC10 125mm Base	100mm AC10
Medium Residential Traffic Light Industrial/Commercial	30mm AC 10 200mm Base	125mm AC 10
Other	See AustRoads "Pavement Design" Manual	

Table D13.9

12 Where council has determined to accept unsealed pavements the wearing surface shall consist of materials with low percentage of fines such as recycled asphalt. In some instances, loading and manoeuvring areas may be unsealed flexible pavements, however, these areas are high maintenance and must be considered when accepting unsealed surfaces.

STANDARD DRAWINGS

D13.100 LIST OF DRAWINGS

List of Drawings

1.	DRAWING NUMBER	DRAWING DESCRIPTION
	WSC.D1.5	Industrial and Commercial Vehicular and Footway Crossing
	WSC.D1.8	Residential Vehicular and Footway Crossing
	WSC.D1.11	Vehicular Access Profiles
	WSC.D1.16	Standard Rural Pipe Crossing and Gate Setback
	WSC.D1.17	Standard Kerb Ramp Crossing
	WSC.D1.18	Turning Path Template for Design Cars
	WSC.D1.21	Turning Path Template for Rigid Vehicles (service and Waste Recovery Vehicle)
	WSC.D1.22	Manoeuvre Template for Rigid Vehicles (Service and Waste Recovery Vehicle)