TWEED SHIRE COUNCIL

DEVELOPMENT DESIGN SPECIFICATION

D1

ROAD DESIGN

VERSION 1.4

SPECIFICATION D1 – ROAD DESIGN

CITATION

This document is named “Tweed Shire Council, Development Design Specification D1 - Road Design”

ORIGIN OF DOCUMENT, COPYRIGHT

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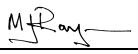
VERSIONS, D1 ROAD DESIGN

VERSION	AMENDMENT DETAILS	CLAUSES AMENDED	DATE ISSUED (The new version takes effect from this date)	Authorised by the Director of Engineering
1.1	Original Version		1 July 2003	
1.2	Reference Standard Drawings and updated Cross Section tables to be consistant with drawings.	D1.03 (c) Table D1.7 Table D1.8	4 August 2003	
1.3	Additions to referenced standard drawings	D1.03	1 June 2004	
1.4	Update referenced standards and RTA/RMS Revision of maximum cul de sac length and number of serviced allotments to provide consistency with DCP-A5 Revised lot frontages to cul de sacs Road upgrades for infill development Revised road cross section elements, with additional notes. Industrial road cross section expanded to include commercial land use Amended footpath allocations for street lights Footpath and Cycleway design revised to reference updated standard drawing and D9	D1.03 and various D1.09.5 D1.09.5 D1.14.7 D1.14, Table D1.7 and notes D1.15, Table D1.8 D1.16, Table D1.9 deleted	13 August 2014	

	Landscaping references to D14	D1.16.11, D1.18.3		
	Footpath crossfall corrected to 2.5% to reflect standard drawings, and revised handrail requirements for urban footpaths	D1.16.4		
	Location of boundary retaining within private land	D1.16.6		
	Tactile markers deleted	D1.16.7		
	Revised minimum kerb return radius for access street intersections	D1.17.15		
	Delete repetition of road hierarchy requirements for bus routes	D1.21		
	Require sealed shoulders on Class C and above Rural Roads to cater for cyclists; Allow gravel road formation for subdivisions on low volume rural roads.	Table D1.11 and notes		
	Updated Rural Property Access requirements	D1.30		
	New fencing clause,	D1.35		
	Update to reflect organisation structure	Various		

DEVELOPMENT DESIGN SPECIFICATION D1

ROAD DESIGN

GENERAL

D1.01 SCOPE

1. This specification provides design criteria for the detailed geometric and structural design of subdivision roads. Road design is to include provision for all road/street users and stakeholders including vehicles, pedestrians, cycles, people with disabilities, public transport, services, utilities, drainage, where appropriate to support frontage development.

Road design criteria, subdivision design and street layout

Subdivision design will determine the general lot layout; general road and intersection location and horizontal alignment; and is dealt with in DCPA5.

Prior to submitting a development application for subdivision, the proposed subdivision design and street layout must be checked to ensure they are physically able to satisfy the geometric requirements of this specification, given the topographical and fixed constraints of the site.

2. Small lot rural residential subdivision is defined as

Urban or rural road design

- Subdivisions where the average lot size, excluding residual and non residential lots is <5,000m2

Urban street design criteria shall be used for urban and small lot rural residential subdivisions.

Rural road design criteria shall be used for all other rural subdivisions (other than small lot rural residential) and for rural connecting roads to urban subdivisions.

3. Good geometric road design satisfactorily resolves the inherent goal conflict embodied in the “Objectives” below.

D1.02 OBJECTIVES

1. Road design is to:

Objectives

(a) Provide acceptable levels of safety, convenience and amenity for all street users and adjacent residents in accordance with the roads hierarchical status.

(b) Support frontage development, shops and commerce where appropriate.

(c) Ensure each road link properly reflects its role based on its status and role in the wider road network and that there is a clear distinction between functional classes of streets based on status, legibility, convenience, traffic volume, vehicle speed, public safety and amenity.

(d) Provide for public transport to a level consistent with potential future demand, ensuring associated infrastructure confers on all classes of users the dignity to which they are entitled, and which is accessible on foot from most dwellings

(e) Provide safe, convenient and legible cycleways

(f) Provide a safe, convenient and legible movement network for people with disabilities, including those using wheelchairs and similar aids

(g) Provide a safe convenient and legible movement network for pedestrians, between residences and to points of attraction in and outside the subdivision, and in particular optimise the walkable access to and into centres, schools, public transport stops, parks and other destinations

(h) Provide attractive streetscapes which reinforce the diverse functions of a street and enhance the amenity of residents, leading to a safe, distinct and pleasant environment, with tree planting, landscaping and street furniture that does not adversely impact on the movement of pedestrians and cyclists, street lighting or the integrity of services and drainage systems.

(i) Provide sufficient width of road and verge to allow streets to perform their designated functions within the street network, and provide a road edge that is appropriate for control of vehicle movements; performs any required function; and is structurally adequate and detailed to reflect pedestrian and cyclist "desire lines".

(j) Provide street geometry which is safe and appropriate to the street function

(k) Provide on street parking where required, including parking for people with disabilities

(l) Allow access for special vehicles for building collection, utility servicing, commercial deliveries, furniture removal, fire fighting and other emergency services

(m) Minimise the total asset and ownership costs for the life of the road(s)

(n) Accommodate public utility services and drainage systems.

(o) Provide adequate levels of street lighting in accordance with AS/NZS 1158.

The references in D1.03 pursue and elaborate these principles. They are commended to designers as Best Practice guides to follow when about to embark on major urban design projects.

D1.03 REFERENCE AND SOURCE DOCUMENTS

In cases of conflict or contradiction, unless otherwise specified, the provisions of this Specification will prevail over all reference documents and prevail over all Tweed Shire Council Standard Drawings.

(a) Primary Reference Documents ***References***

DCP Section A5 - Subdivision Manual
- Appendix A - Subdivision Works - Development Design Specifications

- Appendix B - Subdivision Works - Development Construction Specifications

West Australian Planning Commission,

- *Liveable Neighbourhoods - Edition 2, 2000*.
- *Liveable Neighbourhoods - Street Layout, Design and Traffic Management Guidelines, June 2000.*

(b) Secondary References

Council Publications

- Tweed Shire 2000+ Strategic Plan 1997. Chapter 8.
- Tweed Shire LEP 2000 - Designated Roads.
- DCP Section A2 Site Access and Parking Code.
- DCP Section A9 Energy Smart Homes Policy
- Development Design Specification D3 - Structures, Bridge Design
- Development Design Specification D5 - Stormwater Drainage Design
- Development Design Specification D6 - Site Regrading
- Development Design Specification D9 - Cycleway and Pathway Design
- Development Design Specification D13 - Engineering Plans (Subdivisions)
- Development Design Specification D14 - Landscaping Public Space

Australian Standards

- AS 1742.(1 –15) Manual of Uniform Traffic Control Devices
- AS/NZS 1158 Lighting for Roads and Public Spaces
- AS/NZS 4586 Slip Resistance Classification of New Pedestrian Surface Materials

Federal Authorities

- Commonwealth Department of Housing and Regional Development, 1995, AMCORD - *A National Resource Document for Residential Development* Parts 1 & 2 and Practice Notes AGPS, Canberra
- AUSTROADS
  - *Guide to Road Design*
  - *Guide to Traffic Management*
  - *Design Vehicles and Turning Path Templates*
- Australian Road Rules (Australian Transport Council and National Road Transport Commission) 1999
- Disability Discrimination Act (Australian Human Rights Commission) 1992

State Authorities

- Roads and Maritime Services (previously Roads and Traffic Authority NSW)
  - *Supplement to Austroads Guide to Road Design.*
  - *Guide to Traffic Generating Developments*
  - *Guide to Signs and Markings Reference List*
  - *Sharing the Main Street - A Practitioners' Guide to Managing the Road Environment of Traffic Routes Through Commercial Centres,* 2nd Edition
- Queensland Department of Communication and Information, Local Government and Planning, 1999, *Shaping Up - A Guide to the Better Practice and Integration of Transport, Land Use and Urban Design Techniques* QDCILGP Brisbane.
- Queensland Department of Local Government and Planning, 1997 *Queensland Residential Design Guidelines*
- NSW Department of Housing - *Managing Urban Stormwater - Soils and Construction*, August 1998

Other

- The Institute of Municipal Engineering Australia, Qld Division - 1993: *Queensland Streets: Design Guidelines for Subdivisional Streetworks.*
- *Water Services Association of Australia's Water and Sewer Guidelines (WSAA)*

(c) Tweed Shire Council Standard Drawings that apply to this Section:

S.D. 001	Urban Road Cross Sections – Sheet 1
S.D. 002	Urban Road Cross Sections – Sheet 2
S.D. 003	Urban Road Cross Sections – Sheet 3
S.D. 004	Urban Road Cross Sections (Water Sensitive Urban Design) – Sheet 1
S.D. 005	Urban Road Cross Sections (Water Sensitive Urban Design) – Sheet 2
S.D. 006	Service Locations in Roadways – Sheet 1
S.D. 007	Service Locations in Roadways – Sheet 2
S.D. 008	Standard Kerb Details
S.D. 009	Rural Road Cross Sections – Sheet 1
S.D. 010	Rural Road Cross Sections – Sheet 2
S.D. 011	Driveway Access to Properties Fronting Unkerbed Roads
S.D. 012	Subsoil Drainage Details
S.D. 013	Footpath & Cycleway Details
S.D. 014	Standard Kerb Ramp Details
S.D. 015	Flat Top Road Hump Detail
S.D. 016	Bike Path Slowdown Control –'Z' Chicane
S.D. 017	Driveway Access To Properties Fronting Roads With Kerb & Gutter
S.D. 401	Standard Street Name Sign
S.D. 403	Regulatory Sign Erection Details
S.D. 701	Tree & Shrub Planting Details
S.D. 707	Tubular Steel Fencing

D1.04 PLANNING CONCEPTS

1. Council's Local Environmental Plan and various locality related Development Control Plans and Section 94 Contribution Plans may already specify network layout, geometric standards and/or access limitations for roads in particular locations. These normally prevail over other considerations. ***Statutory Planning***

2. Neighbourhood planning and determination of the road network is addressed in DCP A5, Chapter 3 - Planning and Designing a Subdivision and Chapter 4 - Urban Subdivision Design Guidelines and Development Standards. ***Neighbourhood planning, road network***

3. A traffic study is required to determine expected subdivision traffic volumes and impact on the surrounding road network. It is to include recommended internal hierarchical classifications and intersection treatments; plus necessary upgrading of existing roads, intersections and connecting roads to accommodate increased traffic. A traffic study is not necessary for subdivisions which create no more than 15 new lots and do not create new intersections. The level of detail of the traffic study will be dependent on the scale of the development. ***Traffic study***

D1.05 PLAN AND DRAWING REQUIREMENTS

See Development Design Specification D13. ***D13***

D1.06 ROAD CROSSFALLS

1. Roads are normally crowned at the centre and shall have the following crossfalls on straight alignment: ***Crossfalls***

a.	Asphaltic Concrete	0.030 (1 in 33)
b.	Concrete	0.020 (1 in 50)
c.	Bitumen flush seal	0.040 (1 in 25)
d.	Bitumen sealed shoulders	0.040 (1 in 25)
e.	Gravel shoulders (adjacent asphalt)	0.040 (1 in 25)
f.	(adjacent flush seal)	0.050 (1 in 20)

2. There are many factors affecting levels in urban areas which may force departures from these crossfalls. Differences in level between kerb alignments can be taken up by offsetting crown lines or adopting one-way crossfalls. ***Variances***

   Where steeper or flatter crossfalls than normal are required, for example at intersections, or turning circles of cul-de-sacs, the maximum and minimum permissible pavement crossfalls shall be 1 in 20 and 1 in 50 respectively. The minimum grade shall always be obtained in at least one (1) direction on the pavement surface.

   See also **D1.13 (Superelevation)**

URBAN STREET DESIGN

D1.07 URBAN GENERAL

1. This section does not address general lot layout, road and intersection locations. This is addressed in DCP A5 Chapter 3 - Planning and Designing a Subdivision. ***DCPA5***

2. The primary reference document for urban area street design and layout for DCP A5 is West Australian Planning Commission - *Liveable Neighbourhoods, Edition 2, 2000* and its accompanying document *Liveable Neighbourhoods - Street Layout, Design and Traffic Management Guidelines.* Urban and rural residential street design shall be designed in accordance with DCP A5 and its references unless otherwise directed by this specification. ***Liveable Neighbourhoods***

3. Note that urban street design generally does not require the provision of superelevation, curve transitions or constant radii as applicable to rural road design.

4. Street block layout should limit street length to 350m for access streets and speed may become an issue with Neighbourhood Connectors at uninterrupted lengths above 600m. Where street block layout cannot be adjusted to limit street length or when additional speed control is needed speed control devices are to be used to break up the interrupted length. Examples of these devices are: Horizontal deflection devices (e.g. Elliptical slow point, chicane, one-lane slow point *); Vertical deflection devices (not generally favoured); Roundabouts. ***Street Length***

   *must be restricted to roads with volumes less than 3,000 vpd.

D1.08 URBAN DESIGN SPEED

1. Design speed reflects traffic efficiency. The quality of the road environment for ***Affect of design***

local residents and non-motorised traffic diminishes as design speed increases, so that higher design speeds are only contemplated where traffic efficiency is considered of over-riding importance compared to its adverse environmental effects. The priority of vehicles over pedestrians will be progressively reversed as the designer proceeds down the road hierarchy from arterial/distributor roads to access streets. ***speed***

2. Where lower traffic speeds are desirable a combination of a low design speed, speed control devices placed in the road, and prioritised intersections should be adopted. Good design assists drivers to interpret perceived hazards, available sight distance, and other visual cues as setting the speed environment, rather than relying on regulatory signage or police enforcement. Any changes in the prevailing speed environment should be signalled, legible and progressive. ***Low Speeds***

3. The maximum speed limit on urban local roads in Tweed Shire is 50kph, which may sometimes be appropriate for design of streets (see 5.), although street type, safety & topography issues will frequently dictate lower values. The RMS will not approve speed zones lower than 50kph without concurrent installation of appropriate physical speed control devices. ***Speed Limits***

4. Vehicle speed on local streets can be limited by several design techniques including: ***Control of vehicle speed***

   (a) road width being appropriate to traffic volume and parking demand, so traffic is impeded and slowed by parked and opposing vehicles, but, capacity is not unduly constrained;

   (b) short leg lengths between street junctions and/or slow points (tight corners, bends or traffic calming devices) to encourage speeds of 30 to 40 km/hr or less;

   (c) visually and physically tight intersections (small kerb radii); trees near road or in parking lane (by using parking indents) to narrow the road appearance

   (d) intersection controls including stop signs, narrowed throats and raised pavements, mini roundabouts, or more complex traffic management devices

5. The local street network should be designed to normally produce the target maximum speeds shown in Table D1.1, but, lower design speeds are to be adopted approaching intersections, when local conditions, adjacent land use, safety, road geometry or topography indicate that lower design speeds are appropriate. ***Maximum speeds***

   Slow points are to be introduced in accordance with Table D1.1, D1.2 and D1.3. Where bends, slow points or intersections which allow speeds greater than 20 km/h are used, the length of street between two bends or slow points is to be as specified in Table D1.3.

   Slow points including either horizontal or vertical deflection or constrictions are designed to slow traffic to a desired speed. (Vertical deflection devices will not be approved on roads designed for volumes greater than 1,000 vpd due to noise generation issues at night.)

Street type	**Target Maximum street speed**	**Maximum Leg length between 20km/h slow points ***	
		If parked cars are likely to be on street	No parked cars likely to help achieve speed control
Access Street (5.5 - 6 m road width)	40 km/h	200 m	140m
Access street (7 - 7.5 m road width)	50 km/h	250 m	180m
Neighbourhood connector	60 km/h	600 m	220m

Table D1.1: Street Length and Design Speed

* Leg length is distance between intersections or junctions, or points and locations where vehicles must slow to a maximum of 20 km/h. End conditions that reduce vehicle speed to 20 km/h may include; T intersections, roundabouts; and devices in Table D1.2.

Bend type	**Road width (m)***		
	3.5 m	5 - 5.5 m	7 - 7.5 m
Single bend	60^o	70^o	90^o
Chicane - two reverse bends	30^o - 30^o	5^o - 45^o	60^o - 60^o

Table D1.2 Minimum road deflection angles for speed control to 20 km/h

* Raised medians must be incorporated in above bends to prevent cutting of corners. Wider pavements may be reduced to 3.5m carriageways at bends, provided they are still negotiable by waste collection trucks.

Speed at slow/ point/bend (km/h)	**Max leg length of street between slow points/bends (parked cars likely on street) to limit target maximum street speed to:**			
	40 km/h		50 km/h	
	Parked cars likely to be on street	Parked cars unlikely to be on street	Parked cars likely to be on street	Parked cars unlikely to be on street
20	200m	140m	250m	180m
25	130 m	80m	210 m	135m
30	110 m	65m	180 m	115m
35	80 m	50m	160m	100m
40	-		125m	80m
45	-		95m	60m

Table D1.3 Maximum length of street between slow points with speed greater than 20km/hr

Note: The installation of speed control devices often restricts on street parking, property access, and the safe passage of bicycles. Device positioning is therefore intimately connected with lot layout.

D1.09 URBAN HORIZONTAL ALIGNMENT

1. Drivers react to restrictive horizontal alignment by slowing to an appropriate speed. The desired maximum speed is maintained by designing a restrictive horizontal alignment

Horizontal alignment restricts speed

2. Sharp curves. The following requirements allow for safe passing and the occasional heavy vehicle.

Curve radii, widening

Minimum curve radius on carriageway centreline

Access street	10 m
Neighbourhood connector	15 m

Carriageway widening.

(Apply to inside kerb line by using a larger radius for inner kerb)

Radius less than 20 m	1.0 m
Radius 20 m to 30 m	0.5 m

3. The minimum radii applying to various design speeds are shown in Table D1.4

Minimum curve radii

Horizontal Curve Radii	
Design Speed (kph)	Minimum Radius (m)
10	10 (and check turning templates)
20	13
30	20
40	30
50	50
60	90
70	**150**

Table D1.4

For local access roads curve radii should preferably range only between the minimum and the next highest ranking in the above table, in order to limit vehicle travel speeds to appropriate levels.

4. The minimum horizontal sight distance is measured along the vehicle path and shall be in accordance with Table D1.5. ***Sight Distance***

Horizontal target speed (km/h)	**Sight distance required** (m)
20	20
25	30
30	40
35	50
40	60
50	80
60	110

Table D1.5 Minimum Horizontal Sight Distance (1.15m to 1.15m)

5. Cul-de-sac maximum length is 100 m, servicing no more than 12 dwellings or lots, and with no more than 15% of lots in a neighbourhood on cul-de-sacs. Where constrained by landforming limits, the maximum length may be increased to 200m and serving no more than 24 lots, if it can be demonstrated that this leads to better urban design outcomes. Cul-de-sacs are to be placed in a through street reserve, so that pedestrians and cyclists have continuous access and longer-term connection for other traffic is possible. Cul-de-sacs should be located so that they do not impede the overall interconnectivity of the system. A cul-de-sac is to be designed on the basis that it will connect in future if traffic volumes rise. If the cul-de-sac head is onto a foreshore or other reserve where no future road is contemplated, the public road reserve shall be continued full width until meeting the reserve in order to preserve street vistas and a sense of public ownership. ***Cul de sacs***

   The minimum radius of kerb and gutter, both within the turning circle and in the approaches to the turning circle shall be 9.0m in residential/rural residential subdivisions and 12.5m in industrial subdivisions. Verge width shall not be less than 3.0m at any point in or approaching the turning circle.

   A minimum lot frontage of 12.5m, or 9.0m of kerb frontage (whichever is the greater) is required for each lot in a cul-de-sac.

D1.10 URBAN LONGITUDINAL GRADIENT

1. The minimum centreline gradient may be 0% however the minimum kerb and gutter gradient at any point shall not be less than 0.3% except at crests. Roads with flat longitudinal gradients may require variable cross falls to maintain minimum kerb and gutter gradient. Maximum gradients are shown in Table D1.6. For grades greater than 12% the requirements for pedestrians, cyclists, waste collection vehicles and transverse access are to be addressed explicitly in the design. Grades on the inside of curves and the grade for turning vehicles at T-intersections require special design consideration. ***Flat and Steep Terrain***

Road type	Desirable maximum grade %	Absolute maximum grade %
Arterial / Distributor	6	8
Neighbourhood connector	8	12
Access street (urban or rural residential)	10	16
Access lane	8	12
Cul-de-sac head	5	5
Industrial	6	10

Table D1.6

2. Longitudinal grade through intersections should not exceed 4 per cent, the actual gradient being dependent on the type of terrain. Generally grades will be maintained on the priority road, with the side roads adopting the priority road cross-fall where they join the priority road carriageways. (Adjusting with 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 acceptable.)

Intersections

D1.11 URBAN VERTICAL CURVES

1. A vertical curve, of parabolic form, shall be provided at every crest and at other changes of grade of more than 1%. Vertical curves should generally be as long as possible for improved appearance; but surface drainage must be maintained in proximity to summit and sag points. Irrespective of road centreline grading at sag vertical curves, the kerb and gutter grade shall not fall below 0.3% at any point. For crest grade changes of <1%, the length of vertical curve in the gutter shall be 15m only; accommodating the road grade variance in the parking lane crossfall.

Vertical Curve placement, drainage must be maintained

2. **Minimum Length of Vertical Curves**

Minimum length of vertical curves

(a) **Crest Curves**:
The minimum length of a crest curve is governed by sight distance requirements for the adopted design speed.

(b) **Sag Curves**:
(i) desirable minimum to be based on providing minimum headlight sight distance
(ii) absolute minimum to be such that vertical acceleration does not exceed 0.10G.

(c) Minimum Length for Appearance
Except for crest changes of grade of <1% the minimum length of a vertical curve shall not be less than:

Access Road	25m
Neighbourhood connector	30m except at intersections

3. (a) Vertical curve length in side roads at T intersections can be reduced

Vertical curves at intersections

(b) The minimum length of such vertical curves shall be not less than 10m or

on a local access road L = 0.7A
on a neighbourhood connector L = 1.25A

L = minimum length of vertical curve
A = the change of grade between the side road and the crossfall of the through road

(c) The tangent point of the vertical curve in the side road shall be located at, or behind the kerb line of the through road.

D1.12 URBAN VERTICAL SIGHT DISTANCE

1. The absolute minimum sight distance is that required for a driver to perceive an object 0.15m high on the road ahead, and stop before reaching that object. This distance shall be available at every point on every road, using the approved design speed. ***Vertical sight distance***

2. The desirable minimum sight distance for two-way roads is that required for the drivers of two opposing vehicles to perceive the other, and to stop both vehicles before meeting. This sight distance is to be provided at intersections and wherever possible. ***Two way roads***

3. The minimum sight distance at intersections shall be ***Safe intersection sight distance (SISD)***

   (a) Sufficient distance for an approaching vehicle to stop before an obstruction in the road at an intersection (see table D1.5)

   (b) Sufficient distance for a vehicle stopped in a side road, at the alignment of the through road, to start and turn safely onto the through road (see Table D1.5)

D1.13 URBAN SUPERELEVATION

1. Superelevation will not be required in the majority of urban streets, which have design speeds less than 60 kph. Access streets which are designed for speeds of 40 km/h or less and with curves of 60 m radius or less generally have the pavement crowned on a curve instead of superelevation. Design standards for such curves have little meaning as drivers usually cut the corners and rely on friction to hold them on a curved path. Adverse cross-fall should be limited to 3%. ***When to use superelevation***

2. The maximum superelevation for urban roads of higher design speeds should be 6 per cent. Any increase in the longitudinal grade leading to excessive crossfall at intersections should be considered with caution. While it is desirable to Superelevate all curves on high-speed roads, negative crossfall should be limited to 3 per cent. ***Negative Crossfall***

3. The minimum radius of curves is determined by the design speed; the minimum superelevation (or maximum adverse crossfall) at any point on the circular portion of the curve depends on the maximum coefficient of side friction. Table D1.4 incorporates a maximum coefficient of side friction of 0.15 where there is assisting cross fall. This should be recalculated for a coefficient of 0.12 where there is adverse crossfall. ***Coefficient of Side Friction***

4. Recommendations for minimum curve radii (in metres) on major urban roads under varying superelevation / crossfall are found in AUSTROADS ***AUSTROADS***

5. Superelevation of urban roads reduces high side gutter hydraulic capacity to zero, and can lead to dangerous sheet flow across the pavement during storm events. In these locations special interception provisions are required to eliminate the risk of such sheet flow. ***Sheet flow***

D1.14 URBAN CROSS SECTION ELEMENTS

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, streetscaping and tree planting. Table D1.7 details carriageways and footway widths and road reserve widths. ***Functions***

2. Cross-section element specifications in Table D1.7 are strongly influenced by Council's statutory obligation to pursue Ecologically Sustainable Development (ESD), with particular relevance to ecologically sustainable transport – this presently being confined to self powered walking and cycling. It is also widely held that public transport is more sustainable than use of the private automobile. In addition, the elements are framed on the presumption of compliance with Council's ESD expectation of designs embodying neighbourhood self-containment to the highest degree possible. An identified small local neighbourhood commercial centre and/or transport node should be within 400 metres walk of 90% of dwellings. For this concept to gain effective community acceptance, all pedestrian and cycle paths must have high levels of safety, efficiency, security and amenity. They must also enjoy a micro-climate advantage over the rest of the street. In sub-tropical Australia this implies efforts to maximise shade, shelter, and wind breaks. Higher usage routes should also provide access to respite (seating), refreshment (bubblers), and relief (public toilets). Section D1.16.11 specifies criteria for verge landscaping.

Ecologically Sustainable Development

3. All urban and rural residential roads shall have kerb and gutter on both sides. Where Water Sensitive Urban Design (WSUD) is adopted, kerb and gutter may be substituted with flush kerbs and associated bollards or castellated kerbs to prevent vehicle egress onto the verge. WSUD will generally involve conveying street drainage (formerly conveyed in kerb and gutter) in grass swale drains located on the road verge, with the verge being widened to accommodate the swale.

Kerb and gutter. For Water Sensitive Urban Design, adopt flush kerb with bollards

Kerb and gutter shall have a vertical face to prevent vehicles encroaching on footpaths as prescribed in the Australian Road Rules, 2000.

Pram ramps shall be provided at all footpath/road crossings

4. In industrial subdivisions all road junctions and cul-de-sac bulbs shall be concrete paved as far as the tangent points of kerb returns.

Industrial areas

5. Standard Cross-section elements, for use in any special cases where standard road types are inapplicable, shall be:

Lane widths

Travel Lane	absolute minimum	3.0 m
	slow speed	3.4 m
	standard	3.7 m
	one-way	4.0 m
Parking	access street	2.6 m
	Major road	3.0 m
Turn Lane	minimum	3.0 m
	Standard	3.4 m

6. Cross section gradients must comply with criteria in this specification; cut/fill batters are not permitted within the road reserve. Council may consider low maintenance retaining structures (eg. in median of a divided road) to accommodate level differences across a road reserve.

Cut/fill batters

7. Where infill development requires upgrades to existing road cross-sectional elements (including pavement, and road surface) due to increased traffic generation, these upgrades shall extend to the nearest external intersection with a higher order road.

In Fill Development

Table D.1.7 Function and characteristics of roads - Urban Cross Section Elements

Street type and function	Street characteristics	Target design speed km/h[2]	Indicative max volume (vpd)[1]	Indicative street reserve width (m) [13]	Indicative road pavement width [3] min (m)	Verge width min each side (m)[5]	Parking provision within street reserve	Kerb type	Footpath [10]	Cycles
URBAN AREAS										
Laneways Provide access to the side or rear of lots principally for access to garages. Must be provided behind all properties in commercial zones or retail shopping strip precinct.	Laneways may incorporate services and provide rubbish collection. Used when smaller lot layouts justify rear access to garages and where alternative vehicle access is needed for lots fronting major streets, parkland or conservation areas.	15	300	6+ [4]	6	nil	No	Barrier or flush edge strip depending on surface stormwater containment	No	Share with vehicles
Access Streets To accommodate shared pedestrian, bike and vehicular movements. The requirements of adjacent land uses to be supported by street design	Narrower access streets Appropriate in locations further away from centres and activity centres, where there is a low demand for on street parking. Max travel distance before connecting to wider access street 200m.	40	1,000	13+ [3] 17+ for WSUD [3]	6	3.5 see [9] for WSUD	Yes	Barrier or see [9] for WSUD	1 x 1.2	Share with vehicles
	Standard access streets To cater for higher traffic volumes over longer distances, closer to neighbourhood centres, more intensive land and higher density land use or where flexibility is required for future land uses	50	3,000	14.5+ [3] 18.5+ for WSUD [3])	7.5	3.5 see [9] for WSUD	Yes	Barrier or see [9] for WSUD	1 x 1.2	Share with vehicles
	Wider access street with bus route (including school buses). Refer D1.21 for bus route provision.	50	3,000	16+ 20+ for WSUD	9	3.5[11] see [9] for WSUD	Yes	Barrier or see [9] for WSUD	1 x 1.2	Share with vehicles

Street type and function	Street characteristics	Target design speed[2]	Indicative max volume (vpd)[1]	Indicative street reserve width	Indicative road pavement width	Verge width min each side	Parking provision within street reserve	Kerb type	Footpath	Cycles
Access Streets (Continued)	Industrial access streets For use in industrial or commercial areas and/or where regular use by heavy or articulated vehicles is anticipated	50	8,000	20+ 24+ for WSUD	13 min	3.5 see (9) for WSUD	Yes	Barrier or see (9) for WSUD	2 x 1.2	Share with vehicles
	Shopping strip access street For use where shops are adjacent to a street. If shops one side only adjust appropriately	30	10,000	30+	21 includes 11m carriageway and 5m each side for angle parking	4.5 on side with shops may be 3.5 on side with no shops	Angle parking adjacent to carriageway Bus bays to be provided each way	Barrier	Full width adjacent to shops(12), may be 1x1.2 on other side of road if shops on one side only	Share with vehicles
Neighbourhood connectors Streets with predominantly residential frontage, typically provide lower order sub arterial network. Service and link neighbourhoods and towns.	Low volume neighbourhood connector. To cater for higher volumes than wider access streets. Undivided road with two traffic lanes and two parking lanes.	60	5,000	18+ 22+ for WSUD	11	3.5 or 4 min if accommodating 2.5 footpath or cycleway see (9) for WSUD	Yes	Barrier or see (9) for WSUD	<3,000 vpd, 2x1.2 >3,000 vpd 1x2.5 (6) +1x1.2	Share with vehicles (7) Shared footpath
	Normal neighbourhood connector. 2 lane undivided or may have median for reasons of access, character or pedestrian safety, Design with regard to context, function and adjacent land use. Where densities >15 dwellings per hectare, and/or business or mixed use development is anticipated, wider reserves may be required to accommodate additional parking.	60	7,000	20.9+ 24.4+ for WSUD Additional width required for medians.	13.4 (2 lanes) or 2x6.8 lanes with median	1 x 3.5 & 1 x 4.0 to accommodate 2.5 footpath / cycleway see (9) for WSUD	Parking indents or on carriageway	Barrier or see (9) for WSUD	1x1.2 + 1x2.5 (6)	Shared footpath

Street type and function	Street characteristics	Target design speed[2]	Indicative max volume (vpd)[1]	Indicative street reserve width	Indicative road pavement width	Verge width min each side	Parking provision within street reserve	Kerb type	Footpath	Cycles
Neighbourhood connectors (Continued)	Shopping strip neighbourhood connector For use where shops adjacent to a connector. If shops one side only adjust appropriately	30	10,000	30	21 includes 11m carriageway and 5m each side for angle parking	4.5 on side with shops may be 3.5 on side with no shops	Angle parking adjacent to carriageway Bus bays to be provided each way	Barrier	2.5 adjacent to shops, may be 1x1.2 on other side of road if no shops that side	Share with vehicles [7]
Arterial or Distributor Roads Will be designated as such in Tweed Road Contributions Plan	Design based on performance criteria and designated in Tweed Road Contributions Plan or use values to the right as a default minimum		>10,000	30+ 34+ for WSUD	2x10 + 3 median	3.5 or 4 if accommo-dating 2.5 footpath or cycleway see [9] for WSUD			1x2.5 [6] +1x1.2	Shared footpath

Table D.1.7 Function and characteristics of roads - Urban Cross Section Elements (Continued)

Notes to Table D1.7

1. Traffic volumes are to be derived using approved advanced computer cumulation techniques from the trip generation rates of the Tweed Road Development Strategy. For single dwelling allotments apply a traffic generation rate of 10 vehicles per day (vpd)/allotment (equivalent to approximately one vehicle per hour (vph) in the peak hour) unless a lower rate can be demonstrated. For multi-unit dwellings apply a traffic generation rate of 6 vpd or a rate based upon local data.

2. Streets are to be designed to achieve the target speed, and sight distances to accord with the design speed.

3. Widening is required at bends to allow for wider vehicle paths (using AUSTROADS Turning Templates, refer also to D1.09.2). Wider reserves may be needed to cater for varied service requirements, lane widths or intersections.

4. Access (service) lanes are required to be incorporated behind all properties in 3(c) Commercial Zones, or any other retail strip shopping precinct. A flush pavement edge treatment is be used in residential applications.

5. Verge width must accommodate relevant services, landscaping and noise attenuation methods. Ensure the total setback is sufficient to satisfy the prescribed traffic noise exposure levels at the facade of residential dwellings.

6. Where two 1.5m wide cycle lanes are marked on carriageway a minimum 1.2m footpath is required. Refer to Section 94 Contributions Plan No 22 "Cycleways".

7. In accordance with AustRoads "Guide to Traffic Engineering Practice, Bicycles" Part 14.

8. Where a CP22 – Cycleways route occurs in a subdivision road reserve, that road reserve (and the road pavement width if a shared cycleway) is to be widened by 2m.

9. Water Sensitive Urban Design (WSUD) principles are encouraged. Where road longitudinal gradients are >1% and <5%, grass swale drains may be substituted for kerb and gutter. In such cases flush kerbs are to be used on road edges with either bollards or castellated kerbs used to exclude traffic from the verge. The verge width is to be increased to a minimum 5.5m to accommodate the swale drain without interfering with other utility service allocations. Road Reserves to be adjusted accordingly.
Unless otherwise approved by Council, driveway surface levels are to be flush with the verge/swale surface and designed to accommodate a standard vehicle without bottoming.

10. Refer S.D.013 Footpath and Cycleway Details for design requirements.

11. Localised verge widening may be required to accommodate bus shelters and other public transport infrastructure along bus routes.

12. Full width footpath required along shop frontages, unless otherwise specified in Council endorsed landscaping plan.

13. Wider reserve may be required for intersections, lane widths or service requirements

D1.15 FOOTPATH AND UTILITY SERVICE ALLOCATIONS

Utilities and services shall be in accordance with Table D1.8 ***Utilities***

Verge Width	**Corridor** (all distances in metres)						
	Distance from property boundary				Distance from back of kerb towards property boundary		Distance from kerb face towards road centreline
	Spare (Retro fit gas, telco)	**Shared Trench Arrangement for Telecommunications Electricity and Gas**	**Water, Sewer Rising Main ***	**Footpath**	**Trees**	**Grass Swale Drain**	**Underground Stormwater**
3.5	Verge too narrow	0.9 - 1.8	1.8 - 2.4	0.8 - 2.0	0.6 to trunk centre, 1.05 clear zone	Verge too narrow	0 - 2.4+ Lids located to avoid wheel paths
4.0	0.75 - 1.2	1.2 - 2.1	2.1 - 2.7	1.1- 2.3 or 0.3-2.8 for cycleway			
4.5							
5.5				1.1- 2.3 or 0.6-1.8 for WSUD		See Std Drawing	0 - 2.4+ or may be located under swale

TABLE D1.8 Verge Utility Location

Note:

- *Shared trench arrangements are to be in accordance with the above allocations and the general provisions of "Shared Trench Agreement – Country Region of NSW" between ActewAGL, AGL, Essential Energy, Optus, Origin Energy and Telstra.*
- *Street light poles to be placed in accordance with AS/NZS 1158.1.2:2010. Minimum pole setback 0.7m from face of kerb.*
- *Where 3.5m wide verges are proposed, streetlights are to be located on the opposite side of the road to water mains and sewer rising mains where ever practical. If this cannot be achieved, the verge width is to be increased to 4.0m, unless arrangements to accommodate all services are deemed satisfactory by Council.*
- *In the corridor nominated for water and sewer, separations as per the Water Services Association of Australia's Water and Sewer Guidelines (WSA03-2002-2.3 Section 4.10 and WSA 02 -002-2.3 Section 4.4) must be adhered to. In some circumstances this may result in the need to place water mains on one side of the street and sewer on the other side.*

- *WSUD = Water Sensitive Urban Design*
- *Refer to Standard Drawing S.D.006 and S.D.007 Service Locations in Roadways (Sheet 1 and 2)*
- *Longitudinal placement of services must take into account likely future driveway locations for each allotment. In order to comply with urban design and energy efficiency requirements of DCP-A1 and BASIX, residential driveways will generally be located close to the southern / western property boundary (depending on lot orientation). As such, each allotment should be provided with a zone 8.0m long from the southern / western boundary clear of street trees, light poles, footpath pram ramps, kerb inlet pits, and the like.*

* Gravity sewer may be located in this corridor (e.g. industrial subdivisions) provided:

- The landform in adjacent private allotments is unsuitable for sewer location
- Water supply can be located in the verge on the other side of the road
- The water and sewer corridor is widened to 1.6m with complimentary widening of the verge to accommodate the widened corridor
- The depth to sewer invert does not exceed 2.5m

D1.16 URBAN FOOTWAYS AND CYCLEWAYS

1. Following the national adoption of the Australian Road Rules, vehicles are now prohibited from parking or standing on the road verge or footpath. The historical practice of providing layback kerbs invited drivers to partially or totally mount the footpath when undertaking on-street parking. Table D.1.7 nominates vertical face (barrier) kerb in most applications henceforth in order to deter drivers from obstructing the footpath in this way. Garage door setbacks to a minimum of 5 metres are proposed elsewhere in Council's development control framework to assist similarly in protecting footpaths from illegal obstruction. (Note this does not apply to garages & carports without doors or gates.)

   Where layback kerbing is already installed, paved footpaths should be rendered inaccessible to parking vehicles by physical barriers or prohibitive planting.

   Footpath Protection

2. Suburban street footways should be set back from the face of kerbs to allow sufficient room for safe door opening for passengers alighting at the kerb, grading of entry driveways from gutter up to footpath level, planting of shade trees, erection of street lighting poles, and provision of turf filter strips to intercept the nutrients in surface runoff. Table D1.8 specifies verge footpath location.

   Footpath location

3. Following the adoption of the Australian Road Rules, juveniles are permitted to ride cycles on all footpaths. Design clearances to obstructions as specified in the '*Guide to Traffic Engineering Practice – Bicycles'* should therefore be observed on all footpaths for safety reasons.

   Clearances

4. Crossfalls in footway paving should not exceed the 2.5% required by the Disability Discrimination Act (DDA). Longitudinal grade usually parallels that of the road and this may inevitably be steeper than the seven per cent (1 in 14) specified in the DDA . Handrails may be provided in limited locations where it is justified by topography, surrounding landuses, and where the handrails do not provide a hazard to traffic or pedestrian safety.

   Grades and Crossfall

5. Local adjustments to the above standards may be acceptable for the preservation of trees, or accommodation of various existing objects. Special finishes may be required when longitudinal grades are unavoidably excessive. Designers should be able to demonstrate that such variances do not compromise safety. ***Variances***

   Paths below kerb level are undesirable but may be used if normal crossfalls are impracticable. Effective drainage and alighting passenger safety must then be demonstrated.

6. Differences in level across the road between alignments may be accommodated by: ***Level differences.***

   (a) Widening the road reserve sufficiently to enable all standard road cross-section elements to be fully developed.

   (b) Addition of retaining walls and batters. Handrails, pedestrian barriers and ramps may then be needed to satisfy DDA provisions.

   Level differences between the road reserve and private allotments must be taken up by batters or retaining walls located wholly within private land and in accordance with Development Design Specification D6 - Site Regrading.

7. Footpath and cycleway pavements shall be constructed in Grade N25 concrete to the standards in Standard Drawing S.D.013 Footpath and Cycleway Details. Paving blocks and other treatments will be considered on their merits, but, must have the same load carrying capacity as the standard concrete pavement. Footpaths and dual use paths must have a durable, non-skid surface in accordance with AS/NZS 4586. Tactile marking is no longer to be provided, on advice from the RMS. ***Pavements, surfaces, tactile marking***

TABLE D1.9 DELETED (Version 1.4)

8. Footpaths and cycleways shall be designed in accordance with D9 - Cycleway and Pathway Design, and Austroads "*Guide to Road Design Part 6A: Pedestrian and Cyclist Paths*" ***Design - D9, AUSTROADS***

9. Pedestrian laneways shall be provided with 1.5m minimum width pathways or 2.5m width if part of the cycleway network with the pavement designed in accordance with S.D.013). Designers shall submit proposals for low maintenance landscaping for the balance of the area whilst providing sufficient cross-section area for any overland flow path for stormwater. ***Pedestrian laneways***

10. No roads, driveways, footpath, kerb and gutter, drainage or any other structures may be placed or constructed on an existing road reserve unless prior consent has been obtained from Council under s138 of the Roads Act 1993. S138 application forms and fee schedule are available from Council. ***Consent under s138 Roads Act required***

11. Road verges shall be landscaped in accordance with D14 - Landscaping Public Space and Standard Drawing S.D.701. All plantings must provide for adequate sight distances at intersections, pedestrian access, and space for door opening with minimal maintenance. Plantings shall be selected and located to ensure they do not adversely affect drainage or other utility services. ***Verge landscaping***

D1.17 URBAN INTERSECTIONS

1. See also section on design speed. ***Warrants***

   Note: Warrants in this section refer to those in AUSTROADS, Guide to Road Design Part 4: Intersections and Crossings - General.

2. Normally intersections will be at-grade uncontrolled, channelised, or a roundabout (see D1.18). Traffic signals will very rarely be required. The design of intersections or junctions should allow all movements of vehicles, cyclists and pedestrians to occur safely without undue delay. Projected traffic volumes should be used in designing all intersections or junctions on local arterial/distributor roads. ***Traffic Volumes***

3. 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 publication AUSTROADS Guide to Road Design Part 4. In urban areas this will require raised concrete medians. ***Main Roads***

4. Intersections with main roads, regional roads or state highways are to be designed and constructed in accordance with the requirements of the Roads and Maritime Services and the Director of Engineering. ***Regional Roads, State Highways***

5. 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. ***Remediation***

6. The safety of pedestrian and cyclist users will be a paramount consideration in the selection of intersection type. ***Pedestrians and cyclists***

7. Intersections should be generally located in such a way that: ***Intersection location criteria***

   (a) The streets intersect at right angles.

   (b) The landform and parking controls allow clear sight distance on each of the approach leg of the intersection.

   (c) The minor street intersects the convex side of the major street, if on a curve.

   (d) Two side streets intersecting another street in a staggered pattern should have a minimum centre-line spacing of the design speed in metres (e.g. 40kph = 40m).

   Other criteria are in the AUSTROADS *Guide to Road Design Part 4.*

8. All vehicle turning movements are to be accommodated utilising AUSTROADS Design Vehicles and Turning Path Templates, as follows: ***Turning Movements***

   (a) For turning movements involving distributor roads, the "design semi-trailer" with turning path radius 15.0 m.

   (b) For turning movements involving neighbourhood connectors or bus routes, but not arterial/distributor roads, design for the AUSTROADS 14.5 metre long rigid bus with a minimum turning path radius of 15.0 m.

(c) For turning movements on access streets but not involving arterial/distributor roads or neighbourhood connectors, design for the AUSTROADS 12.5 metre long single unit truck/bus with an absolute minimum turning radius of 12.5 metres.

(d) For turning movements at the head of cul-de-sac streets a minimum 9m radius is required

9. On bus routes 3-centred curves with radii 7.0 m, 10.0 m, 7.0 m are used at junctions and intersections. ***Bus Routes***

10. Channelisation is required (unless grade separation or roundabouts provided) at: ***Channelisation***

(a) arterial/distributor with arterial/distributor intersections

(b) arterial/distributor with neighbourhood connector intersections

(c) neighbourhood connector with neighbourhood connector connections (if warranted)

Channelisation should:

(a) provide separate and clearly defined paths for each traffic movement, and provide passage for cyclists and pedestrians

(b) minimise the general area of conflict by causing opposing traffic streams to intersect at (or near) right angles

(c) maximise separation of conflict points

(d) merge traffic at small angles

(e) control approach and crossing speed by funnelling or bending traffic paths

(f) provide refuge for turning or crossing vehicles at signalised intersections as required

(g) prohibit certain turns

(h) provide pedestrian protection and pram ramps where appropriate

(i) improve the efficiency and layout of signalised intersections

(j) provide sites for signs and traffic signals

(k) be lit at night (mandatory if kerbs or other rigid obstructions are introduced to the carriageway) to AS/NZS 1158 requirements

(l) improve and define alignment of major movements

(m) not obstruct pavement drainage

Channelisation is to accommodate a design semi-trailer of 19m in length, providing a minimum clearance of 0.6m between the wheel track and kerbs at all points.

Medians and traffic islands shall be constructed with concrete mountable type kerb. Minimum median 400mm, standard medium 600mm.

11. Traffic Control at 4 - Way Intersections shall be in accordance with the following: ***4 way intersections***

(a) Arterial/Arterial 4-way intersections to be signal (where warranted) or high capacity roundabout controlled (roundabouts may be inappropriate in high pedestrian/cyclist activity areas).

(b) Arterial/Neighbourhood Connector 4-way intersections to be signal (where warranted) or roundabout controlled (roundabouts may be inappropriate in high pedestrian/cyclist activity areas).

(c) NC/NC 4-way intersections to, be roundabout controlled (10-12 m inner island diameter) with adequate vehicle path deflection (refer to *AUSTROADS* Guide to Road Design Part 4B: Roundabouts) to keep speeds low.

(d) NC/Access Street 4-way intersections should be minimised by altering street block layout. Roundabouts are to be used for speed control and intersection safety.

(e) AS/AS 4-way intersections (should also be minimised as above) to be controlled by small roundabouts (mountable are acceptable).

12. Traffic Control at T-Junctions shall be: ***T junctions***

(a) Arterial/arterial T-Junctions to be signal (where warranted) or high capacity roundabout controlled (roundabouts may be inappropriate in high pedestrian/cyclist activity areas).

(b) Arterial/Neighbourhood Connector T-Junctions to be signal (only occasional where warranted) or roundabout controlled (roundabouts may be inappropriate in high pedestrian/cyclist activity areas). Side road may be controlled by stop/give way/median permitting left turn only depending on volumes and nearby signals as alternative access.

(c) NC/NC T-Junctions to be provided with roundabouts (10-12 m inner island diameter, refer to *AUSTROADS* Guide to Road Design Part 4B: Roundabouts) for speed control benefits even if volumes are acceptable.

(d) NC/Access Street T-Junctions may require roundabouts for speed control and intersection safety. Normal control by T Junction rule favouring the NC.

(e) AS/AS T-Junctions, control by T-junction rule.

13. The access street network is to be configured to manage traffic volumes, traffic speeds and run up length at Access Street/Access Street 4-way intersections to enable safe application of a priority (give way) controls. ***Managing speed, volume***

14. Corner 3 x 3 metre truncations are to be provided as a default in the local street network, provided a minimum of 3m verge is available between kerb face and property boundary. The truncation must be increased above 3m to ensure there is a minimum of 3m between kerb face and property boundary where the geometry of the corner or demands for road widening would otherwise encroach on the verge, ***Corner truncations***

Exceptions to the default:

(a) Intersection treatments that require more space

(b) Acute angle intersections and intersections on the inside of a small radius curve

(c) Narrow frontage lots may warrant reduction of truncation provided adequate accommodation is provided for 3m footpath at corner, services, and sight distance from stop/giveway lines.

15. Default minimum kerb return radius requirements

Kerb return radius

AS/AS	10m
AS/NC	10m, increase if median on NC
NC/NC	Will depend on roundabout design requirements, but minimum 10m

Industrial areas and to any higher order road 12m

Arterial/distributor routes must be designed to cater for articulated vehicles, and have minimum kerb return radius 15m

D1.18 ROUNDABOUTS

1. Roundabout designs are to be approved by the Director of Engineering. ***Approval***

2. Roundabouts should be designed in accordance with the requirements of the publication AUSTROADS Guide to Road Design Part 4B: Roundabouts. Roundabout design should always provide for safe passage of pedestrians and cyclists. ***AUSTROADS***

3. Landscaping requirements for the centre island will be determined in accordance with D14. ***Landscaping***

4. Roundabouts are required at:

   (a) Neighbourhood connector and access street intersections where this option is needed to reduce street lengths to those nominated in Table D1.1

   (b) 4-way intersections identified in D1.17.11

   (c) T-intersections identified in D1.17.12

   AUSTROADS Guide to Traffic Management Part 6: Intersections, Interchanges and Crossings identifies appropriate and inappropriate sites for roundabouts (Table 2.3 and 2.4).

D1.19 TRAFFIC CALMING

1. Calming devices such as thresholds, slowpoints, speed humps, chicanes and splitter islands should be designed in accordance with AUSTROADS Guide to Traffic Management - Part 8: Local Area Traffic Management, and “Sharing the Main Street" (RMS 2000). These will require Local Traffic Committee approval. Device designs should generally comply with AS 1742 - Manual of Uniform Traffic Control Devices

2. AUSTROADS

Streetscape

(a) Streetscape

(i) reduce the linearity of the street by segmentation

(ii) avoid continuous long straight lines (e.g. kerb lines)

(iii) enhance existing landscape character

(iv) maximise continuity between existing and new landscape areas.

Location

(b) Location of Devices/Changes

(i) devices other than at intersections should be located to be generally consistent with streetscape requirements

(ii) existing and future street lighting, drainage pits, driveways, parking needs, and utility services will control the exact location of devices

(iii) slowing devices are generally located in accordance with D1.07 Design Speed.

Design Vehicles

(c) Design Vehicles

(i) emergency vehicles must be able to reach all residences and properties

(ii) bicycles should not have to move into the path of motor vehicles to negotiate devices.

(iii) local streets with a 'feeding' function between arterial roads and access streets should be designed for an AUSTROADS 14.5 metre long rigid truck/bus. See Standard Drawing S.D.015. Note that platform is to be 6m long on bus routes.

(iv) raised platforms are not permitted where they are likely to be used as pedestrian crossings by pedestrians. (see RMS Technical Direction), and vertical deflection devices are generally discouraged in suburban and retail areas, due to impacts and problems with emergency vehicles and public transport.

Vehicle Speeds

(d) Control of Vehicle Speeds

(i) maximum vehicle speeds can only be reduced by deviation of the travelled path. Pavement narrowings may have only minor impact on average speeds, and usually little or no effect on maximum speeds in circumstances where there is good forward visibility, unless the carriageway is reduced to a single path (even then, only if a vehicle is approaching from the opposite direction).

(ii) 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)

(iii) 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. Increasing access activity by (say) provision of angle parking is also effective.

Visibility

(e) Visibility Requirements (sight distance)

(i) 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

(ii) sight distance to be considered include those of and for pedestrians and cyclists, as well as for drivers

(iii) night-time visibility of street features must be adequate. Speed control devices particularly should be located near existing street lighting and if not existing then lighting is to be installed as per AS/NZS 1158, and all street features/furniture is to be delineated for night time operation.

(f) Critical Dimensions

Critical dimensions

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

(i) pavement narrowings

- single lane 3.50 m between kerbs

  3.75 m between obstructions

- two lane 5.50 m minimum between kerbs

(iii) bicycle lanes (included adjacent to pavement narrowings) - 1.35m minimum

(iii) plateau or platform areas

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

(iv) width of clear sight path through slowing devices

- 1.0 m maximum

(i.e. the width of the portion of carriageway which does not have its line of sight through the device blocked by streetscape materials, usually vegetation)

(v) dimensions of mountable areas required for the passage of large vehicles to be determined by appropriate turning templates.

D1.20 PARKING

1. All off-street parking shall be in accordance with Council's DCP A2 - Site Access and Parking Code

DCPA2

2. Adequate on-street parking should be provided within the road reserve for visitors, service vehicles and any excess resident parking since a particular dwelling may generate a high demand for parking. Such parking is to be convenient to dwellings. Bearing in mind driveway crossovers are 4.5m minimum, an average of at least one on-street carpark per single (or dual occupancy) frontage lot should be provided, except for battle-axe blocks with "handles" longer than 20m. Visitor parking for other higher density developments is prescribed in DCP A2.

Resident & Visitor Parking

D1.21 BUS ROUTES

1. Public Transport is covered in *AMCORD* Element 1.5, and *Shaping Up* Chapter 2. Bus routes will normally be identified by Council in conjunction with the operator. It is important that the road hierarchy adequately caters for buses. The main criteria in determining the location of bus routes is that *no more than 10% of residents should have to walk in excess of 400 metres* to catch a bus.

Buses

Bus routes are normally located on neighbourhood connectors and above. It is possible that they could be routed on some wider access streets which have a reasonable length/connectivity, or provide a critical link to a particular destination (hospital, school, sport ground, beachfront). If busses are required to run on a street which would otherwise be an access street the design of the street shall be widened to provide a higher standard. Table D1.7 details minimum criteria for bus route design on access roads.

2. Having consulted with the bus company, and having regard to the above, applicants shall submit a proposed bus route and bus stop schedule for the development. Where proposed bus stops are located outside private property frontages being land which is the subject of the application or an undeveloped part of the overall project, a Section 88(b) instrument shall be applied over an easement created within the immediate frontage of at least 5 metres by 1 metre, for the purpose of footpath widening to accommodate a bus shelter without obstructing public passage. This will signal the intended footpath use to future purchasers and permit later extinguishment at no cost if no longer required.

Bus route proposal

3. Standard Bus Shelters shall be erected at the nominated sites in accordance with Table D1.10 and must be Council's standard design.

Bus shelters

Road	Carriageway Width (min)	Stops (Spacing)	Bays
Neighbourhood Collector	11m	400 metre	Shelters*
Arterial/Distributor	13m	400 metre	Shelters

Table D1.10

* Shelters are subject to Council's requirements.

D1.22 URBAN DRIVEWAYS AND ACCESS

1. Every lot must have feasible access from the street. Care is to be taken with short frontages that an access corridor is available after allowing for kerb lintels, poles, structures and trees etc.

Access to every lot

2. Right of Way Access

Right of way access

Where access is on a right of way over another property, the following minimum standards apply:

Benefited Properties	Standard of Access
1	100mm roadbase, 3m wide, 2 coat seal, drainage
2 (or reciprocal)	150 reinforce concrete, 3m wide, drainage, passing bays
3 to 5	as for above but 4.5m wide

Note: Easement/right of way shall be 1 m wider than the pavement and any associated batters, catch drains or service corridors.

The maximum number of allotments that may share in the above access arrangements is 5.

3. Battle Axe (Hatchet Shaped) Blocks - Minimum Standard of Access

Battle axe, hatchet shaped lots

Width shall be a minimum 4m, plus width required for earthworks, batters, retaining walls, longitudinal drainage and services.

For multiple leg accesses with reciprocal rights of way the provisions of 2 above shall also apply.

4. Where street grades in excess of 12% are approved, the designer will limit the number of property access frontages to that section. Where frontage is provided, the feasibility of gaining safe property access shall be demonstrated, paying regard to driveway grade (including edge line grades) footpath continuity and combined crossfall.

Street grades

D1.23 URBAN ROAD DRAINAGE

1. See Development Design Specification, "D5 Stormwater Drainage Design".

D5

2. Bridges

Bridges

Bridges are to be designed in accordance with Development Design Specification D3 - Structures, Bridge Design. Bridges are to have low maintenance finishes (timber and steel are not normally acceptable). Provision for pedestrians and on-road cyclists is required and is to be consistent with the footway/cycleway provision in approach streets. Bridges must accommodate current and future utility service in concealed conduits. Urban bridges must be provided with lighting, handrails, road edge kerb and railings.

RURAL ROAD DESIGN

D1.24 RURAL GENERAL

1. This section does not address general lot and road layout. This is addressed in DCP A5 - Chapter 3 - Planning and Designing a Subdivision and Chapter 5 Rural Subdivision Guidelines and Development Standards.

Scope

2. Rural subdivision roads shall be designed in accordance with this section. In this standard "rural" road design does not include road design in Zone 1(c) Rural Living subdivisions where the average lot size, excluding residual lots and non residential lots, is <5,000m^2. Such Zone 1(c) subdivision road design shall be in accordance with the "urban" road design section of this specification.

3. Designers shall obtain a rural address for each new land parcel created in accordance with Council's Rural Addressing Policy and provide for erection of a conforming rural address number on the property driveway

Rural addresses

D1.25 RURAL STANDARD CROSS SECTIONS

1. Road Class and width is to be determined by estimated ultimate traffic volume, see Table D1.11.

Rural road class

Traffic volumes are to be derived using the trip generation rates of the Tweed Road Development Strategy. The estimates are to account for ultimate development of the land and adjacent areas taking into account all future stages of development and desirable connections to other land.

For single dwelling allotments a traffic generation rate of 6.5 vehicles per day (vpd)/allotment (equivalent to approximately 0.65 vehicles per hour (vph) in the peak hour) is to be used unless a lower rate can be demonstrated. For multiple occupancies adopt half the above rate per MO household.

2. Formation width is to be increased by 1.5m where road safety barrier is to be installed. Road safety barrier is to be installed at approaches to structures and on fill batters over 2.1m high. Where road safety barrier is installed the road shoulder is to be sealed and a 100mm high AC berm is to be constructed to intercept road runoff and prevent it flowing down batter slopes. Runoff so collected is to be conveyed by flume drains to natural surface.

Widening for road safety barrier, earthworks and drainage

Catch drains are to be located on the high side of cuttings prevent runoff flowing down cutting batters. Catch drains are to be concrete lined where longitudinal grades are less than 0.5% or more than 5%.

3. Road reserves are to be of sufficient width to accommodate all roadworks, earthworks (including all cutting and fill batters), drainage structures (including catch drains) and utilities with a minimum clearance of 1m.

4. Where road drainage discharges concentrated flows to locations other than natural watercourses, easements are to be provided to convey such runoff to a natural watercourse or legal point of discharge.

5. Table drains shall be constructed on cutting sides of roads. Table drains shall commence at formation (shoulder) edge and develop a depth of 400mm, 1.6m from the edge of formation. If pavement depth is greater than 350mm, the table drain shall be deepened and widened to ensure it is 50mm deeper than underside of pavement. Table drains are to be concrete lined where longitudinal grades are less than 0.5% or more than 5%. If longitudinal grades are over 8%, (or lesser grades, where soils are such that there is risk of erosion), kerb and gutter and full shoulder seal is to be provided.

Table drains

Rural Road Class	**Class vpd Range**	**Design Speed**	**Road Reserve Width**	**Width of seal** (1)	**Line Marking**(3)	**Unsealed shoulder width (each side)**(1)	**Nominal Minimum width of formation**(1)
Class A (5)	<150	See D1.26	20m minimum, but, sufficient width to accommodate formation, earthworks, fencing, catch drains and any other longitudinal and transverse drainage	4	None	2.3 gravel	8.6
Class B	150-250			6	None	1.3 gravel	8.6
Class C	250-1000			8.6	None	nil	8.6
Class D	1000-2000			9.6	Centre + edges at 3.5m	nil	9.6
Arterial(2)	>2000			11.0	Centre + edges at 3.5m + RRPM (4)	nil	11.0

TABLE D1.11 Function and Characteristics of Rural Roads - Cross Section Elements

(1) Rural shoulders and formation width to be increased to accommodate road safety barrier where warranted
(2) Default characteristics only, general function and characteristics nominated in the Tweed Road Contributions Plan.
(3) Provision for cyclists on Class D roads and above between edge line and edge of seal.
(4) Raised reflector pavement markers to RMS standards
(5) Where a subdivision or other traffic generating development is proposed on an existing unsealed road and the resultant traffic volume on that road will still be <75vpd, then a 6.0m formation with a full width 6.0m gravel pavement (minimum 150mm road base depth, CBR45) is required along the entire frontage of the subject property and extending to the nearest sealed road.

6. Rural road cutting batter slopes shall not be steeper than shown on Table D1.12. If there is evidence of geotechnical instability, batter slope and design is to be in accordance with a geotechnical engineers certified recommendation. A geotechnical expert investigation and report is required for all cuttings deeper than 5m. ***Cut batters***

Material	**Weathering**	**Maximum Slope H:V**
Massive, unjointed, hard rock	Fresh	0.25:1
As above	Fresh - slight	0.5:1
Strong igneous or metamorphic rock with some jointing or discolouration, but, exposed rock not noticeably weaker than fresh rock.	Fresh - slight	0.75:1
Shale, siltstone, sandstone with not more than two joint sets, unaltered joint walls, surface staining only	Fresh - slight	1:1
Moderately weathered rock with no obvious seepage	Slight - moderate	1.5:1
Sandy soil or gravel with minor seepage		2:1
Cohesive soil or completely weathered rock with minor seepage	Extreme	2.5:1
Weathered rock where joint fillings have eroded out	Moderate - high	3:1
Sand		3:1
Cohesive soil or highly weathered rock with obvious seepage problems		4:1
Weathered rock or soil with boulders		4:1

Table D1.12 Cutting Batter Slopes

7. Rural road fill batter slopes shall not be steeper than shown on Table D1.13. ***Fill batters***

8. Notwithstanding 6 and 7 above, batter slope length, berm drain locations and gradient relationships are not to exceed those in Chapter 4, section 4.2.1 (d), (e), (f) and (g) of NSW Department of Housing - *Managing Urban Stormwater - Soils and Construction*, August 1998. ***Batter berm drains***

Material	Maximum Slope H:V
Shale, soft limestone, foliated metamorphic rock	2:1
Other rock	1.5:1
Gravel, gravel with silt or sand, well graded sand	1.5:1
Clayey gravel, silty sand, clayey sand, silty soils	2:1
Fatty clays, elastic silty clays	3:1

Table D1.13 Fill Batter Slopes

D1.26 RURAL DESIGN SPEED

Design speed

1. Design speed shall generally be in accordance with the following table, subject to topographical restraints.

Road Class	**Design Speeds** (kph)
A (Dead End)	30 – 50
A	40 – 60
B	50 – 80
C	50 – 100
D	80 – 100

Lower design speeds with increased pavement width will only be considered where the above standards are demonstrably inappropriate or environmentally unacceptable.

D1.27 RURAL HORIZONTAL ALIGNMENT

Horizontal alignment to suit topography

1. Horizontal alignment on Class A rural roads is to be designed to suit the topography rather than achieve maximum design speeds. Adverse crossfall is only permitted on class A rural dead end roads of length not exceeding 250m.

2.	**Minimum Curve Radii**							
	Minimum Horizontal Curve radii (m)							
Design Speed (kph)	**Superelevation**				**Transition Lengths (m)**		**Centre Line Shift (m)**	**Widening (m) for 2 lane road**
	-3% Adverse	+3%	+6%	+7%	Plan	Super		
30	30	25		20	25	45	1.3	1.7
40	70	50		45	30	50	1.3	1.6
50		90		80	35	55	1.3	1.5
60		140		90	40	60	1.3	1.4
70		200		160	40	60	0.8	1.2
80		300		250	60	80	0.9	1.0
100			460		80	60	0.5	0.8
Note: Radius 301 - 440m not permitted)								

3. **Dead Ends** ***Dead ends***

Dead end roads shall be provided with a sealed turning area, diameter 18 metres. Where topography does not permit circular turning areas cross head type turning areas will be considered.

"No through road" signs are to be placed at start of dead end roads and chevron sight boards are to be provided at dead ends to warn oncoming traffic.

D1.28 RURAL VERTICAL ALIGNMENT

1. Minimum grade 0.5%, maximum desirable 10%, absolute maximum 16% (specific permission of Council is required for exceeding desirable grades and permission will generally only be considered for lesser class roads). Parabolic vertical curves to be provided where grade change greater than 1%. ***Vertical grade and curves***

Minimum Length of Vertical curves			
Crest Curves	Length for each 1% change of grade		
Design Speed	Normal	At Intersections	Min VC Length
30	0.8	1.2	10
40	2.2	2.9	25
50	4.4	8.8	30
60	7.8	15.7	35
70	13.9	27.8	40
80	22	43.5	50
100	49	98	60

Sag Curves	
Design Speed	Length for each 1% change of grade
30	1
40	2.5
50	6.6
60	10
70	14.9
80	20
100	33.4
Where absolute maximum gradients are approached, designs should demonstrate these are not exceeded on the inside edge of horizontal curves.	

D1.29 RURAL INTERSECTIONS

Intersections

1. Intersections are to be designed in accordance with AUSTROADS Guide to Road Design Part 4 on the basis of ultimate rather than current volumes. On all roads directly linking villages, the safe movement of cyclists and pedestrians through the intersections shall be demonstrated. On other roads its need shall be addressed. Signage, linemarking and lighting in accordance with relevant standards is required.

D1.30 RURAL PROPERTY ACCESS

Access

1. Each lot shall have a minimum 3 metre wide 2 coat bitumen sealed driveway, on a minimum 150mm depth roadbase pavement, constructed from the road to 3m inside the property boundary to Council's "Driveway Access to Property - Design Specification". If a gate is to be installed, it shall be 3.6m wide (minimum) and situated a minimum of 3m inside the property boundary, unless alternate arrangements are approved by Council. The driveway location must be such that internal 2-wheel drive access can be constructed from the driveway to the nominated building site. The driveway must be located on the subdivision road at a location where there is sight distance from both driveway and road of:

Design Speed (of road)	**Sight Distance required**
30	30
40	35
50	50
60	70
70	95
80	115
90	145
100	180
110	215
120	260

Battle axe access

2. "Battle-axe handle" access. The minimum width of the handle shall be demonstrably in accordance with D1.22.2 above. Multiple separate, but contiguous battle-axe handles are not permitted and must be amalgamated into a reciprocal right of way.

3. Right of Way Access ***Right of way***

Where access is gained by right-of-way through another lot, the access road shall be constructed in accordance with road standards except that the pavement and formation width may be reduced to:

3.6m full width seal	Access to 1 or 2 properties
4.5m full width seal	Access from 3 to 5 properties

Note: Easement/right of way shall be 1 m wider than the pavement and any associated batters, catch drains or service corridors.

The maximum number of properties that may use a common right of way access is 5.

4. Designers shall demonstrate that sufficient room exists at the road end of rights-of-way or battle axe handles for erection of the requisite number of private letterboxes and standing of garbage bins that are accessible but clear of traffic. If not, legal and physical road widening shall be provided to accommodate them. ***Room for letterboxes and garbage pickup***

5. Internal accesses shall be designed and shaped (or transverse drainage structures constructed) to ensure longitudinal access runoff is not discharged to the public road surface. Except for natural streams and gullies, only un-concentrated runoff from catchments that naturally drain to the road reserve will be permitted to discharge to the road reserve. ***Access drainage not to discharge onto public road formation***

D1.31 RURAL ROAD DRAINAGE

1. Rural road drainage is to be designed in accordance with Development Design Specification, "D5 Stormwater Drainage Design" except as varied by this specification. ***Rural road drainage***

2. In rural subdivisions the existing natural drainage pattern will be maintained. Drainage works will be confined to that required to drain subdivision roads.

3. Transverse drainage facilities will be provided across roads to enable runoff to pass from upstream to downstream side in a manner that avoids damage to the road and adjacent upstream or downstream property. Transverse drainage will normally be accommodated by installation of culverts. For larger waterways bridges (or in restricted circumstances causeways) will be required.

4. Longitudinal drainage systems will be provided along roads where this is necessary to safeguard the integrity of the road and to convey sheet drainage to transverse drains.

5. Subsoil drainage will be provided where necessary to preserve the structural strength of the road. It shall be provided in all rural road cuttings.

6. Design to be based on "Australian Rainfall and Runoff, A Guide to Flood Estimation" Revised Edition 1987, Institution of Engineers Australia.

7. ARI for design of rural road drains and drainage structures shall be in accordance with Table D1.14. Notwithstanding the design selection, the impact of ARI 100 year events must be examined to assess the safety and structural risks to: persons and vehicles; property; stream channel; the road and associated structures. If damage or danger is likely to occur in the ARI 100 year event then the drainage structure must be enlarged or other measures taken (eg embankment/channel scour protection, signage, depth indicators etc) to eliminate risk to the public, vehicles, road, structures, stream channel or adjacent property. Details of such measures, sufficient to withstand design velocities in the ARI 100 year event, must be included with designs.

Structure	**Dwellings served or Road Function**	**Approach Road Flood Status**	**ARI for Trafficable Flood**
Bridges	100+ or inter village connector	Flood free	100
	21 – 100	Flood free	50
	6 – 20	Flood free	10
	1 – 5	Flood free	2
	100+	Flood liable	Commensurate with approach road immunity but minimum 20
	20 – 100	Flood liable	Commensurate with approach road immunity but minimum 10
	6 – 20	Flood liable	Commensurate with approach road immunity but minimum 5
	1 – 5	Flood liable	ARI not specified, low level bridge may be used
Causeways	1 – 5	Flood liable	ARI unspecified
Culverts	100+ or inter village connector	Flood free	50
	Flood bypass road		20
	Other roads		10
Catch, table and other open drains			5

Table D1.14 ARI Values for Rural Road Drainage

Longitudinal drainage

8. Longitudinal drainage will normally consist of table drains and subsoil drains in cuttings and catch drains on the high side of cuttings. Table drains are to be concrete lined where grades are less than 0.5% or more than 5%; If grades are over 8% Kerb and gutter and full shoulder seal is to be provided. Catch drains are to be concrete lined where grades are less than 0.5% or more than 5%.

9. Transverse Drainage

Transverse drainage

Culverts will normally discharge onto natural surface. If culvert outlets or other drainage outlets discharge down embankments, corrugated galvanised half round flumes are required to convey runoff to natural surface. Energy dissipaters are required at flume exits. All headwalls are to be marked with reflectorised guideposts.

Table drains and embankment berm drains are to be relieved with mitre drains, transverse culverts, flumes or discharged into an underground pipe system at intervals not exceeding:

Gradient of Road (%)	Maximum Relief Interval (m)
1	250
2	250
3	250
4	200
5	150
6	120
8	100
10	90
12	80
14	70
16	60

Where transverse drainage discharges onto adjacent land that is not a natural watercourse or waterway, the subdivider must obtain an appropriate drainage easement or reserve over that land.

10. Bridges and Causeways

Bridges and causeways

High-level bridges designed to the ARI specified in Table D1.14 are to be used where conventional culverts are unable to provide sufficient waterway area or site topography is unsuitable for culvert installation. Note that bridges and causeways over declared streams require the separate consent of relevant crown authorities and may require acquisition and extinguishment of native title if foundations are obtained in the streambed.

Causeways or low-level bridges may be considered by Council as an alternative to high-level bridges, where roads leading to the subdivision are liable to flooding and the causeway/low level bridge will serve a maximum 5 dwellings. Causeways will not be permitted at sites where there is evidence of an unstable streambed and risk of excessive scouring to the streambed or banks or excessive deposition.

Bridges must be constructed of low maintenance materials such as reinforced and prestressed concrete, all external steelwork (handrails etc) is to be hot dipped galvanised after fabrication. Timber bridges or bridges with steel girders will not be permitted. Causeways will be constructed of reinforced concrete.

11. Bridge Design

Bridges will be designed in accordance with Development Design Specification D3 - Structures, Bridge Design.

Designs must be prepared by consulting engineers who have a record of competency in this field. The subdivider must submit the name of the proposed

consulting engineer and obtain the approval of Council prior to commencement of bridge design.

Bridges must provide 2 traffic lanes where serving 10 or more dwellings. Council may permit one-lane bridges where up to 9 dwellings only are to be served.

Council will require provision of a footway in areas where 20 or more dwellings will be served and significant pedestrian traffic is likely.

High-level bridges are to be designed for 300mm freeboard in the specified ARI flood and to withstand floodwater and debris impacts from larger events.

Low-level bridges will generally be designed as low as practical to minimise the structural and overturning risk from floodwater and debris.

Bridge abutments and approaches are to be suitably protected from scour and erosion during high water flow.

Where appropriate bridges are to be designed to accommodate other services (water, telephone, sewer, etc).

12. **Causeway Design**

Causeways should be constructed as low as possible to minimise impacts on flood flows and minimise risk of erosion and overturning. Central deck level is generally streambed level plus height of dry flow pipe(s) plus deck thickness. There will be a central deck section and two approach sections. The central section will extend across the entire streambed and beyond the stream bank projection for a distance of 2m on either side. At each end of the central deck section there will be approach deck sections 3m long. The long section of the central section shall be level or slope a maximum of 3% upstream, the approach sections shall slope at a maximum grade of 8% towards the central section. Causeways shall be straight and cross-streams at right angles.

Dry weather flow pipe(s) or box culvert(s) shall be provided under the causeway. The pipe/BC shall be sized to carry average dry weather flow only. Pipe/BC dimensions shall be minimised to keep deck level as low as possible, but, minimum dimension shall be 375mm; or larger if required to reduce likely build up of upstream debris, boulders or silt.

The deck sections shall consist of 150mm thick reinforced concrete with one central layer of F82 mesh constructed on compacted creek gravel or similar material. There shall be 150mm thick, vertical cut off walls constructed at the upstream and downstream edges of the deck for the full length of the central and approach decks. The cut off walls shall be reinforced with a central layer of F82 mesh which shall extend 600mm above the wall and be bent over and cast into the deck pour.

The cut off walls for the central deck shall extend from the deck to a level 1.2m below the deepest point of the streambed. If rock is encountered above this level the cut off walls may be bonded to the rock by dowels drilled 600mm into the rock. Cut off walls for approach decks shall extend 450mm below ground level.

A spillway shall be constructed downstream from the central deck. The spillway shall be sloped at 45^0 and extend from the downstream edge of the central deck to the streambed. At the streambed it shall be terminated in a cut off wall 450mm deep. The spillway shall be bonded to the deck by reinforcing and shall be poured on compacted creek gravel or similar. The spillway shall be 100mm thick concrete with centrally placed F62 mesh.

Concrete lined table drains are to be used on both sides of the causeway and approach roads where the road /causeway cuts through the stream bank profile. Mitre drains are to be used to remove excess stormwater from the road, prior to the causeway approach.

Causeways are better suited to rock or sound creek-crossing areas. For sandy, soft clay and similar locations, bridges are preferred. If there is active erosion on the stream below the proposed site, then a bridge may be required by Council, or if a causeway is approved by Council, then the cut off walls must be 1.2m below the potential erosion level. Maccaferi gabions or Reno mattresses may also be required to protect causeways against erosion.

If there is active deposition in the streambed in the vicinity of the proposed site, a bridge may be required by Council.

D1.32 RURAL ROAD FENCING

1. All new roads in rural subdivisions shall be fenced on the road reserve boundary. Unless required otherwise by Council, the minimum standard fence shall be a four strand barb wire fence strung through drilled split hardwood posts every 3m, strainers at each change of direction and at intervals of not less than 300m. ***Fencing***

TRAFFIC CONTROL DEVICES, SIGNS, PAVEMENT MARKING, ROADSIDE FURNITURE, LIGHTING, FENCING

D1.33 TRAFFIC CONTROL DEVICES, SIGNS AND PAVEMENT MARKING

1. Signs, traffic control devices, guideposts and pavement markings are to be provided to roads, intersections, pathways, cycleways and carparks in accordance with *AS1742.1 - 13 Manual of uniform traffic control devices* and the RMS *Guide to Signs and Markings Reference List*.

2. Street name and community facility name signs are to be provided in accordance with AS1742.5.

D1.34 LIGHTING

1. Electric lighting systems are to be provided for roads (including traffic calming devices, intersections and pedestrian crossings and other outdoor public areas in accordance with AS/NZS 1158 *Lighting for Roads and Public Spaces*. ***Lighting standards***

   The following road elements are to be illuminated to the lighting category specified below:

Road Element	Lighting Category
Lane	P5
Access Streets	P4
Access Streets in Shopping Areas	P3
Neighbourhood Connectors < 7,000 vpd	P4
Neighbourhood Connectors > 7,000 vpd	P3
Public Pathways & Paths through Parks & Cycleways not in Road Reserves	P4
Distributor/Arterial Roads	V4
Car Parks	P11
Traffic Management Devices (including roundabouts)	Horizontal Illuminance min. of 3.5 lx *
Pedestrian Refuge	Horizontal Illuminance min. of 3.5 lx *
Pedestrian Crossing	See AS1158.4-1987
Cluster Housing - Private Roads	P4

TABLE D1.15 Road Element Lighting Category

Category of illumination is defined in AS/NZS 1158.1.1 and AS/NZS 1158.3.1. All lighting designs are to be prepared in accordance with AS/NZS 1158 for the above specified categories.

* Figures 3.1, 3.2 and 3.3 in AS/NZS 1158.3.1 define the roadway area that must be illuminated to the standard specified above.

D1.35 FENCING

1. All street side and median fencing located within traffic clear zones as defined by AUSTROADS Guide to Road Design Part 6: Roadside Design, Safety and Barriers, shall be RMS Type 1 Pedestrian Fencing unless otherwise authorised by Council.

2. All other fencing and balustrades in Council road reserves shall be of tubular steel design in accordance with Standard Drawing S.D.707. Aluminium fencing will not be accepted.