TRUNK ROAD INFRASTRUCTURE STANDARD No. 02

ROAD DESIGN

Supplement to Austroads Guide: Road Design

ACT Government
Territory and Municipal Services

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PREFACE

The Austroads series of Guides for provision and management of road and transport infrastructure provides a level of consistency across all jurisdictions in Australia and New Zealand. All road authorities have agreed to adopt the Austroads Guides as the primary technical reference, together with the relevant Australian and New Zealand Standards.

The Australian Capital Territory has adopted the Austroads Guides, and has issued a revised series of documents to reflect this development in standards and specifications for practice in the ACT. This present document is part of the ACT Trunk Road Infrastructure Standard (TRIS) series spanning the broad scope of road infrastructure development in the ACT:

- TRIS 01 – Road Planning
- TRIS 02 – Road Design
- TRIS 03 – Traffic Management
- TRIS 04 – Road Safety
- TRIS 05 – Asset Management
- TRIS 06 – Pavement Design
- TRIS 07 – Bridges and Structures
- TRIS 08 – Road Tunnels
- TRIS 09 – Project Delivery
- TRIS 10 – Project Evaluation.
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Each of the TRIS documents indicates adoption of the relevant Austroads Guide, sets out specific requirements for implementation in ACT, and calls up more detailed Specifications.

This ACT Infrastructure Standard No.02 - ROAD DESIGN constitutes a supplement to the

AUSTROADS GUIDE TO ROAD DESIGN

The Territory and Municipal Services Directorate accepts the principles and general guidance in the Guide to Road Design. This Infrastructure Standard is issued to clarify any exceptions or additional requirements for implementation in the ACT, and to identify relevant complementary documents.

The design of roads in the ACT must be implemented in general accordance with the Austroads Guide above, and in accordance with specific provisions of this Infrastructure Standard.

Where any differences in practice exist between the Austroads Guide and this Infrastructure Standard, the latter will prevail.

CONTENTS

1 GENERAL

Austroads has released the Guide to Road Design and all state road agencies in Australia have agreed to adopt the Austroads guides to provide a level of consistency and harmonisation across jurisdictions. Consequently the Austroads guides and the Australian Standards referenced in them will become the primary technical references for use within the managing authorities.

The Austroads Guide to Road Design comprises 8 Parts issued in 13 volumes (see Section **Error! Reference ource not found.**). The Parts of the Guide provide information representing up to date knowledge and practice relevant to road design.

This present document, the Trunk Road Infrastructure Standard for Road Design, is issued to clarify, add to or modify the Austroads Guide to Road Design.

The attachments included in this document provide detailed design requirements relating to ACT specific works and prevail over Austroads guides and other guidance and reference documents.

2 GENERAL PRINCIPLES

The ACT Government accepts the principles contained in the Austroads Guide to Road Design with variations documented in this supplement. The general principles and guidelines of the Austroads documents are to be followed wherever appropriate.

The ACT Planning and Land Authority have issued a draft Estate Development Code, DV306, which provides the requirements for subdivision of land within the ACT. This Code contains information on local street standards, public transport, pedestrian and cycling path standards.

The Roads and Maritime Service (RMS-formerly RTA) of NSW issued a series of supplements to the Austroads Guides to complement the general topics with local experience and practices. The RMS Supplement to Austroads Guide to Road Design (referred to here as the RMS Supplement) contains local (RMS NSW) requirements and practices based on the RMS experience.

As a general approach, the provisions of the Estate Development Code will take precedence over the Austroads Guide when the two differ from each other.

For any differences in practice between this ACT Supplement and other ACT complementary materials, the ACT Supplement will apply.

3 REFERENCE DOCUMENTS

The primary reference documents for road design in ACT are as follows:

- Australian Road Rules 2012
- Roads and Public Places Act 1937
- Road Transport (General) Act 1999
- Road Transport (Safety and Traffic Management) Act 1999
- Road Transport (Mass, Dimensions and Loading) Act 2009
- Road Transport (Safety and Traffic Management) Regulation 2000
- ACT Estate Development Code 2012
- Australian Rainfall and Runoff 2012
- Floodplain Protection Guidelines 1995
- ACT Environmental Flow Guidelines 2006
- Environment Protection Act 1970
- ACTEW Water Supply and Sewerage Standards 2000
- Development Control Code for Best Practice Waste Management in the ACT 1999
- ACT Road Safety Strategy 2011
- ACT Road Safety Action Plan 2011
- ACT On-road Cycling Policy
- NSW Bicycle Guidelines 2005.

Details for all reference documents in this section are given in the Reference List.

3.1 GUIDELINES

The primary technical guidance is set out in the Austroads Guide to Road Design, which is structured as follows:

- Part 1 – Introduction to Road Design
- Part 2 – Design Considerations
- Part 3 – Geometric Design
- Part 4 – Intersections and Crossings – General
- Part 4A – Signalised and Unsignalised Intersections
- Part 4B – Roundabouts
- Part 4C – Interchanges
- Part 5 – Drainage Design
- Part 6 – Roadside Design, Safety and Barriers
- Part 6A – Pedestrian and Cyclist Paths
- Part 6B – Roadside Environment
- Part 7 – Geotechnical Investigation and Design
- Part 8 – Design Process and Documentation
- Part 9: Roadside Hazard Management.

Some aspects of road design are also addressed in the following Austroads Guides:

- Austroads Guide to Traffic Management
- Austroads Guide to Road Safety

For consolidated design guidance related to cycling facilities, refer to:
Cycling Aspects of Austroads Guides. Report AP-G88-11, Austroads 2011.

This report contains information that relates to the planning, design and traffic management of cycling facilities and is sourced from Austroads Guides, primarily the Guide to Road Design, the Guide to Traffic Management and the Guide to Road Safety.

3.2 RELATED TECHNICAL SPECIFICATIONS

Design requirements related to road design in ACT are prescribed in the following Attachments to this supplement:

- Attachment A – Street Lighting
- Attachment B – Pedestrian and Cyclist Facilities

Detailed requirements for materials, processes, or procedures specific to road design in ACT are prescribed in:

- ACT Trunk Road Infrastructure Technical Specification No.12 – Street Lighting.
- ACT Trunk Road Infrastructure Technical Specification No.15 – Road Furniture.
- ACT Code for Residential Development (ACTCODE).
- Water Supply and Sewerage Standards, ACTEW.
- Joint Trenching Standards, AGL / Telecom / ACTEW.
- Development Control Code for Best Practice Waste Management in the ACT, Department of Urban Services, September 1999.

Implementation of road design must be undertaken in accordance with these Technical Specifications.

The Austroads Guides and the ACT Specifications refer to the requirements of relevant Australian Standards, in particular:

- AS/NZS 1158 Set-2007, Lighting for roads and public spaces, set
- AS 1428.1 - Design for access and mobility part 1: general requirements for access – new building work
- AS 1428.4 – Design for access and mobility part 4: tactile ground surface indicators
- AS 1742 – Manual of Uniform Traffic Control Devices
- AS/NZS 3845 – Road Safety Barrier Systems
- AS 5100.1: 2004, Bridge design: scope and general principles
- AS 2890.1 Parking facilities - Off-street car parking, Standards Australia
- AS 2890.2 Parking facilities - Off-street commercial vehicle facilities, Standards Australia

Further information can be found in the following documents:
NCHRP Report 350 - Recommended Procedures for the Safety Performance Evaluation of Highway Features, National Co-operative Highway Research Program.
Road planning and design manual, Queensland Main Roads Department, 2000.
Road design guide, New South Wales Roads and Traffic Authority, 1996.
Roadside dining protection – a guideline for local authorities in South Australia, Transport SA, 13 November 2000. (available online at http://www.dhs.sa.gov.au/crash-barriers/)

3.3 LEGISLATIVE DOCUMENTS

The key reference legislation is:
- Utility Networks (Public Safety) Regulations 2001, ACT

4 SUPPLEMENTARY MATERIAL

The following tabulated material indicates elements of the implementation of road design in ACT, as they relate to the content of the various Parts of the Austroads Guide to Road Design. The tables provide advice on any additional ACT requirements, or exceptions, to the provisions of the Guide. Complementary documentation is also indicated where relevant.

Design requirements related to road design in ACT are prescribed in the following Attachments to this supplement:

Attachment A – Street Lighting - This document sets out the requirements to be used by practitioners in the design and installation of street lighting in the ACT.

Attachment B – Pedestrian and Cyclist Facilities. This document sets out the requirements to be used by practitioners in the planning and design of pedestrian and cycling facilities in the ACT.

SUPPLEMENT TO THE AUSTRORADS GUIDE TO ROAD DESIGN PART 1: INTRODUCTION TO ROAD DESIGN PUBLICATION DATE: 2010		
An introduction to the guide, defining its status, purpose and areas of application and describing the functions and content of each of its parts. The context of the road design process within each of the different methods of delivery of road projects is discussed, as are the various aspects of road design philosophy and principles. The concept of a set of key design considerations is introduced. The nature of the road design process, and descriptions of its typical elements, are discussed.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 1 of the Guide is adopted with no exceptions in principle for the practice in ACT	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 2: DESIGN CONSIDERATIONS PUBLICATION DATE: 2006		
Detailed discussion of three important general aspects of design. Firstly, the range of objectives likely to apply to a road design project; these include appropriate recognition of transport demands, safe and efficient traffic operations and achievement of balanced provision for the needs of all road users. Secondly, context sensitive design and the associated concepts of design domain and functional classification of roads; and the vehicular, human and road factors influencing design. Thirdly, a comprehensive, tabular presentation of the broad range of considerations affecting road design.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 2 of the Guide is adopted in principle for the practice in ACT. Austroads documents provide guidance for the design of major roads, including collector and access roads, with design speeds of 40km/h or more, i.e. access streets or higher order roads. The Trunk Road Infrastructure Standards provide guidance for matters relating to the design of road elements. They should also be read in conjunction with the DIS	
3.1	The National Capital Authority (NCA) has responsibility for the following roads: **Main Avenues** • State Circle • Kings Avenue • Commonwealth Avenue • Sydney Avenue • Brisbane Avenue • Hobart Avenue • Canberra Avenue (to Hume Circle) • Melbourne Avenue • Adelaide Avenue • Perth Avenue • Northbourne Avenue • Edinburgh Avenue • University Avenue • Ainslie Avenue • Limestone Avenue (south of Ainslie) • Anzac Parade • Constitution Avenue. **Approach Routes** • Barton Highway • Federal Highway • Fairbairn Avenue • Morshead Drive/Pialligo Avenue to the ACT border • Canberra Avenue from Hume Circle to the ACT border • Monaro Highway and its extension as the Eastern Parkway to Morshead Drive. For these roads the design considerations must include the requirements of the National Capital Authority requirements, which are contained in National Capital Plan.	

Reference Section	ACT Practice, Complementary Material, or Departures	Date
	For these roads the design considerations must include the requirements of the National Capital Authority requirements, which are contained in National Capital Plan.	
	There are roads adjacent to the Canberra airport that are required to meet the requirements of the Civil Aviation Safety Authority (CASA). These roads are: (to be identified)	
2.3.2	The use of design values in the extended design domain or below the extended design domain are only to be considered for brownfields sites, where the Normal Design Domain values are not able to be used or feasible. The use of any design values that would be considered to be in the Extended Design Domain or below the extended design domain are only to be used after obtaining the written consent of the Director/ Manager (position to be nominated)	
2.4.1	The road functional classification for urban local roads is contained in the Estate Development Code DV306. Arterial road classification is in accordance with Table 2.3 of GRD Part 2. The classification of roads in the ACT is set out in: ACT Trunk Road Infrastructure Standard No. 1 – Road Planning.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 3: GEOMETRIC DESIGN PUBLICATION DATE: 2010		
Guidance and information for road designers that is common to the geometric design of road alignments. Covers topics common to geometric design such as operating speed, sight distance, horizontal and vertical geometry, including the coordination of those two elements and consideration of cross-section elements. Provides relevant information relating to the design of on-road cyclist and parking facilities.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 3 of the Guide is adopted in principle for the practice in ACT, in conjunction with the following attachments to this supplement: Attachment A – Street Lighting Attachment B – Pedestrian and Cyclist Facilities The attachments included in this document provide detailed design requirements relating to ACT specific works and prevail over Austroads guides and other guidance and reference documents. The following exceptions are listed below.	
2.2.5	All streets should be designed to accommodate garbage truck turning movements, including the overhang requirements of the truck.	
3.3	Design speeds for local roads are to be in accordance with the Estate Development Code DV 306.	
3.3.1	Road classifications for local roads, to be in accordance with the Estate Development Code DV 306.	
4.1.2	For Staged construction, the following shall apply: If construction of a dual carriageway road (usually a 80km/h+ arterial road) is staged, the width of the first stage carriageway shall be 9.0m. During the first stage of operation, a 4.5m wide shared lane shall be provided in each direction. When the road is duplicated, the existing carriageway shall be line-marked with two 3.5m wide traffic lanes and 2.0m wide cycle lane. The minimum width of the second carriageway shall be 9.0m to allow for the same lane configuration.	
4.2.5	Local road widths are to be in accordance with the Estate Development Code DV 306.	
4.2.5	In addition, laneways may also be treated as follows: **Laneway Width** Laneways vary in width but should be 3 metres minimum to allow sufficient room for pedestrian/cyclist movement, including clearance to overhanging vegetation from within adjoining blocks. This may be increased to 6 metres to accommodate additional services or large overland flows. Where the retention of existing trees within laneways is possible an increase in the width of the laneway may be appropriate. The landscape treatment of laneways must take account of the future maintenance costs. For the 3 metre width a total hard paved surface is the most functional unless this conflicts with the requirements of service authorities. Generally the laneways are no longer than two standard residential blocks and an adequate softening effect can be achieved from the landscaping within the adjacent residential blocks and from the street tree planting at each end of the laneway.	
4.7.1	Median widths Pedestrian / cycle refuges, the minimum width of a pedestrian / cycle refuge is 2.0m.	
4.11.3	Verge widths are to be in accordance with Estate Development Code DV 306.	
4.12	Bus stops are to be located in accordance with the Estate Development Code DV306.	

Reference Section	ACT Practice, Complementary Material, or Departures	Date
5.1	Local roads will be covered under the Development Infrastructure Standards (DIS). All content relating to local roads should reference the relevant DIS document and ACTCODE.	
8.5.6	Minimum grades – The absolute minimum grade acceptable is 0.3%.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 4: INTERSECTIONS AND CROSSINGS – GENERAL PUBLICATION DATE: 2009		
Limited to the design of intersections. When used in conjunction with other relevant parts of the Guide to Road Design and Guide to Traffic Management, provides the information and guidance necessary for a road designer to prepare detailed geometric design drawings that are adequate to facilitate the construction of intersections and crossings.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 4 of the Guide is adopted in principle for the practice in ACT, in conjunction with the following: Section 6 – Fences, Guardrails and Barriers Attachment A – Street Lighting Attachment B – Pedestrian and Cyclist Facilities with the following exceptions:	
5.2	The design vehicle is to include the Tag Steer bus. This vehicle is to be included in the design of roads along bus routes.	
5.6	Buses – allowance is to be made for buses with bicycle racks. ACTION are to approve turning circles for these buses.	
8	Pedestrian crossing - the warrants for a pedestrian crossing are to be in accordance with AS 1742.10.	
9	Cyclist crossings – the requirements of Attachment B – Pedestrian and Cyclist Facilities are to be used in addition to the requirements of this Section.	
9.4	The use of coloured lane markings is to be in accordance with Attachment B – Pedestrian and Cyclist Facilities.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 4A: SIGNALISED AND UNSIGNALISED INTERSECTIONS PUBLICATION DATE: 2010		
Guide Part 4A: Signalised and Unsignalised Intersections Guidance on the detailed geometric design of all at-grade intersections (excluding roundabouts). Some of the guidance may be appropriate for the design of approaches to roundabouts and is relevant to the design of ramp terminals where freeway ramps intersect with the minor road at an interchange. Should be used in conjunction with all other parts of the Guide, in particular: Part 4, Part 4B, Part 4C.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 4A of the Guide is adopted with no exceptions in principle for the practice in ACT and is to be read in conjunction with the following attachments to this supplement: Attachment A – Street Lighting Attachment B – Pedestrian and Cyclist Facilities.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 4B: ROUNDABOUTS PUBLICATION DATE: 2011		
Guidance on the geometric design of roundabouts. Should be used in conjunction with three other parts of the Guide that relate to the design of intersections: Part 4, Part 4A, and Part 4C. Covers design principles and procedure, and provides guidelines for all the key elements for safe and efficient layouts. Provides information on pedestrian and cyclist treatments at roundabouts and related topics such as pavement markings, signs, and landscaping. Includes a new design method for roundabouts that focuses on the entry curvature to achieve a reduction in vehicle approach speeds.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 4B of the Guide is adopted with in principle for the practice in ACT in conjunction with the following attachments to this supplement: Attachment A – Street Lighting Attachment B – Pedestrian and Cyclist Facilities.	
5.3	Cyclists – the use of coloured pavements to be in accordance with Attachment B – Pedestrian and Cyclist Facilities	
	Lighting at roundabouts to be in accordance with Attachment A – Street Lighting	
	Landscaping to be in accordance with Trunk Road Infrastructure Technical Specification No. 09 – Landscape.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 4C: INTERCHANGES PUBLICATION DATE: 2009		
Detailed geometric design of the grade separations, ramps and ramp terminals associated with interchanges, particularly with respect to cross-section, design speed, sight distance, horizontal and vertical alignment, sight distance and the layouts of ramp terminals. Also covers the needs of pedestrians and cyclists, and some aspects relating to pavement markings, signs, landscaping and street furniture		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 4C of the Guide is adopted with no exceptions in principle for the practice in ACT, and is to be read in conjunction with the following attachment to this supplement: Attachment A – Street Lighting	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN
PART 5: DRAINAGE DESIGN
PUBLICATION DATE: 2010

Design for all road drainage infrastructure, except bridges. Guidance on good design process and practice, and focus on the hydraulic design of the drainage systems and facilities, including required design charts and formulae. Detailed information and guidelines on factors that need to be considered in the selection and design of appropriate and effective road drainage. Provides general information on the assessment of rainfall and run-off but requires other key documents to provide detailed information for the determination of water flows for design purposes. Describes the need to control pollution and erosion from road use, road construction and road maintenance activities.

Reference Section	ACT Practice, Complementary Material, or Departures	Date

1.2

The scope of this standard provides guidance only on the management of stormwater within the road reserve.

For drainage for development areas, the requirements of the Development Infrastructure Standards are to be followed.

RAINFALL INTENSITY FREQUENCIES

Designed Rainfall Intensity Frequencies (RFI) using parameters given in Table 2.1 or figures indicated in Table 2.2 shall be adopted.

Table 2.1 IFD Parameters

Parameter	Value
2 year, 1 hour intensity (mm/hr)	22.00
2 year, 12 hour intensity (mm/hr)	4.30
2 year, 72 hour intensity (mm/hr)	1.14
50 year, 1 hour intensity (mm/hr)	43.00
50 year, 2 hour intensity (mm/hr)	8.00
50 year, 72 hour intensity (mm/hr)	2.25
Skewness G	0.24
Geographical factor for 6 minute, 2 year storm	4.28
Geographical factor for 6 minute, 50 year storm	15.55
Latitude	35° S
Longitude	149° E

2.4.3

Table 2.2 Canberra Design Rainfall Intensities (mm/hr)

Duration	Average Recurrence Interval (years)						
	1	2	5	10	20	50	100
5m	55	73	98	115	138	169	194
6	51	68	92	107	128	157	180
7	48.5	64	86	101	120	147	169
8	46.0	61	82	95	113	139	159
9	43.9	58	78	91	108	132	151
10	42.0	55	74	86	103	125	143
11	40.3	53	71	83	98	120	137
12	38.7	51	68	79	94	115	131
13	37.4	49.1	66	76	90	110	126
14	36.1	47.5	63	74	87	106	121
15	35.0	45.9	61	71	84	102	117
16	33.9	44.5	59	69	81	99	113
17	32.9	43.2	58	67	79	96	109
18	32.0	42.0	56	65	77	93	106
20	30.4	39.9	53	61	72	88	100
25	27.1	35.5	46.9	54	64	77	88
30	24.6	32.2	42.4	48.9	58	70	79
35	22.6	29.6	38.8	44.7	53	63	72

40	21.0	27.4	35.9	41.3	48.5	58	66
45	19.7	25.6	33.5	38.5	45.1	54	62
50	18.5	24.1	31.4	36.1	42.2	51	58
55	17.5	22.8	29.7	34.0	39.8	47.8	54
60	16.7	21.7	28.1	32.2	37.7	45.2	51
75	14.5	18.8	24.4	27.9	32.6	39.0	44.1
90	12.9	16.7	21.6	24.7	28.9	34.6	39.1
2.0h	10.7	13.9	17.9	20.4	23.8	28.5	32.2
3.0	8.18	10.6	13.6	15.5	18.1	21.6	24.4
4.0	6.77	8.76	11.2	12.8	14.9	17.7	20.0
5.0	5.84	7.56	9.68	11.0	12.8	15.2	17.1
6.0	5.18	6.70	8.57	9.72	11.3	13.4	15.1
8.0	4.29	5.54	7.07	8.01	9.29	11.0	12.4
10.0	3.70	4.78	6.09	6.90	7.99	9.48	10.7
12.0	3.29	4.24	5.39	6.10	7.06	8.37	9.41
14.0	2.95	3.81	4.85	5.50	6.37	7.56	8.50
16.0	2.69	3.47	4.43	5.02	5.83	6.92	7.79
18.0	2.47	3.20	4.09	4.64	5.38	6.40	7.20
20.0	2.30	2.97	3.80	4.32	5.01	5.96	6.72
22.0	2.15	2.77	3.56	4.04	4.70	5.59	6.30
24.0	2.02	2.61	3.35	3.81	4.43	5.28	5.95
36.0	1.50	1.94	2.51	2.86	3.34	3.99	4.50
48.0	1.20	1.56	2.02	2.31	2.70	3.24	3.66
60.0	1.00	1.31	1.70	1.95	2.28	2.73	3.10
72.0	0.86	1.12	1.46	1.68	1.97	2.36	2.68

Acceptable methods for estimation of runoff flows and applicable parameters for the ACT are given below. Others methods shall be referred to Roads ACT for endorsement.

IMPERVIOUS AREA ASSUMPTIONS

LEASES

When estimating the design flow contribution from individual leases, due allowance should be made for possible future lease improvements and/or urban consolidation.

For single residential leases, the total impervious area selected for drainage design shall be based on the maximum permissible building plot ratio for the development type plus 10% of the total lease area to allow for driveways, carports, surface paving etc.

For all other development types, the total impervious area values provided in Table 2.3 may be adopted.

COMPOSITE AREAS

For larger-scale modelling of urban catchments, sub-catchments are typically composite areas that include leases, road reserves and open space areas etc. Table 2.3 provides typical total impervious area percentages that may be adopted for composite areas.

The Designer shall assess whether the adoption of typical values is accurate enough for the purposes of the drainage analysis. This may be sufficient for preliminary design or master planning, however, a more accurate assessment of total impervious area may be necessary for the investigation of stormwater system failures or detailed design.

Table 2.3 Composite Impervious Area Guidelines

Type of Development	Design Impervious Area (%)
Single Residential	45

Multi-Units	60
Commercial and Service Trades	70
Group and Neighbourhood Shopping Centres	80
Town Centres	90
Industrial	90

RATIONAL METHOD

The following procedures shall be adopted when using the Rational Method for drainage design in urban catchments in the ACT.

The recommended procedures for the Rational Method have been determined from calibration against gauged flood frequency curves derived for catchments in Giralang and Mawson. Rational Method procedures from the latest edition of Australian Rainfall and Runoff shall not be used unless otherwise directed by the Operating Authority.

Partial area effects shall be taken into account in determining peak flow rates.

TIME OF CONCENTRATION

The minimum time of concentration to be considered shall be 5 minutes.

The following relations shall be used for determining the overland flow travel time component (t_0) of the total surface flow time of concentration for catchments in the ACT;

$$t_0 = \frac{107\, n\, L^{0.333}}{S^{0.2}} \qquad \text{for } L \le 200 \text{ m}$$

$$t_0 = \frac{0.058\, L}{A^{0.1}\, S^{0.2}} \qquad \text{for } L > 200 \text{ m}$$

where,

A	=	catchment area (hectares)
t_0	=	overland flow travel time (minutes)
L	=	flow path length (m)
S	=	slope of surface (%)
n	=	Horton's roughness value for the surface (refer to Table 2.4).

Table 2.4 Horton's Roughness Values

Surface Type	'*n*' value
Paved surface	0.015
Bare soil surface	0.028
Poorly grassed surface	0.035
Average grassed surface	0.045
Densely grassed surface	0.060

RUNOFF COEFFICIENT

The following runoff coefficient shall be adopted for all impervious areas;

C_i = 0.90

The following relation shall be used for pervious areas in residential developments with densities in the range of 10-15 blocks per hectare;

$$C_p = 0.91 - 3.14\, i^{-0.594}$$

where,

C_i = runoff coefficient for impervious surfaces

C_p = runoff coefficient for pervious grassed surfaces

i = design rainfall intensity (mm/h)

Appropriate pervious area runoff coefficients should be obtained from Figure 2.5 for public and unleased land, commercial and industrial areas, and residential developments with densities lesser or greater that 10-15 blocks per hectare.

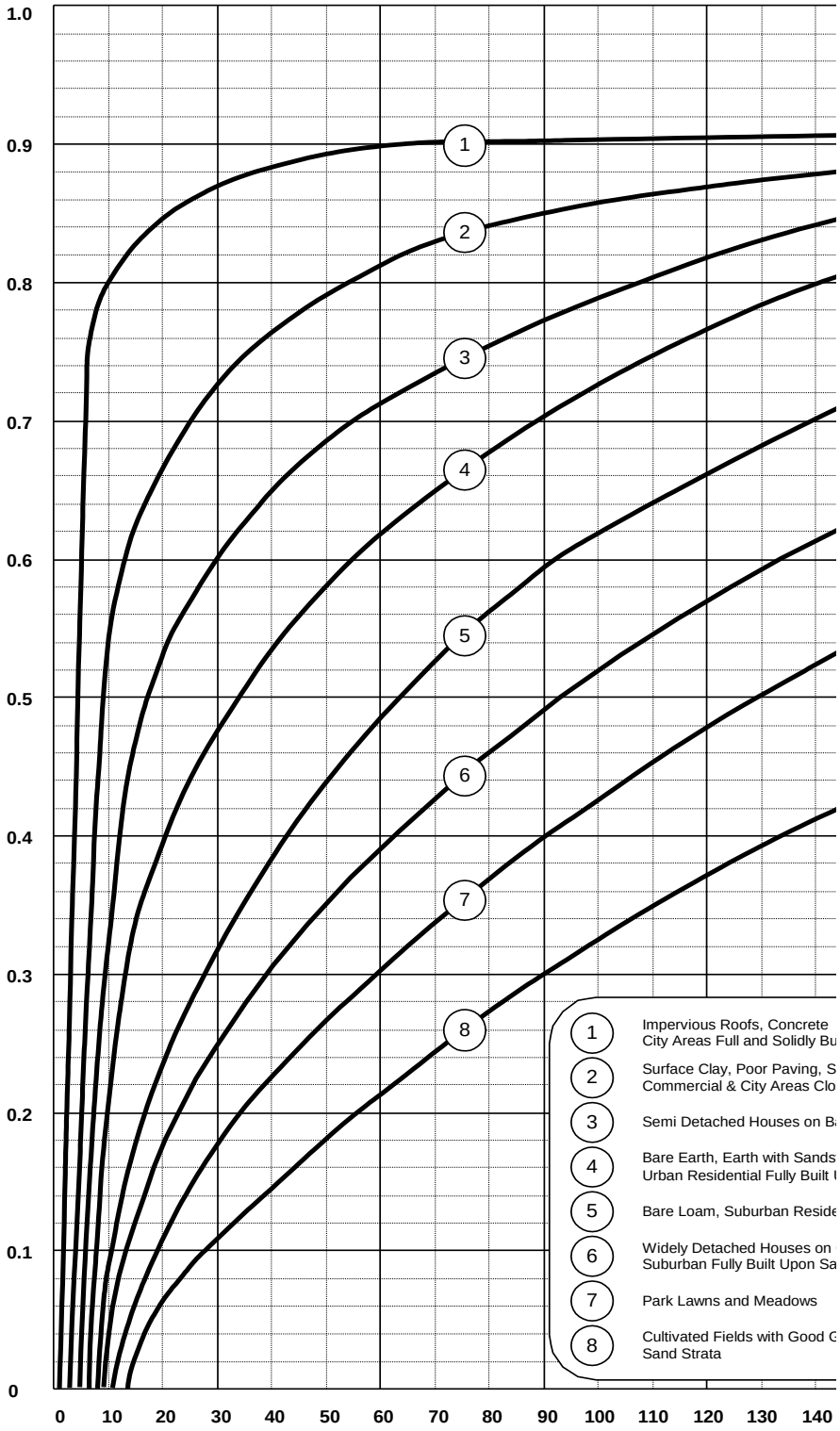


Figure 2.5 Runoff Coefficients for Urban Catchments (Source AR&R 1977)

RAINFALL/RUNOFF MODELS

The parameters recommended for the following selected rainfall/runoff computer programs have been determined from calibration against gauged flood frequency curves for catchments in Giralang, Mawson and Curtin. The calibrations have determined appropriate parameters applicable to individual programs as follows;

- design rainfall loss rate estimation parameters

- surface runoff routing parameters for pervious and impervious areas
- design storm event modelling procedures

These parameters and procedures shall be used in lieu of values and procedures recommended in program documentation and related reports.

RAFTS

RAINFALL LOSS RATES

The Rafts program offers a choice between two approaches to rainfall loss estimation. They are the initial/continuing loss model and the infiltration/water balance procedure which utilises the Australian Representative Basins Model (ARBM). The use of the ARBM loss model shall be used in preference to the initial/continuing loss model due to the ability of ARBM to model a range of ARI events with a single set of model parameters.

The values for the ARBM loss model to be adopted are given in Table 2.5.

SURFACE RUNOFF ROUTING

The recommended surface runoff routing parameters in Table 2.6 shall be adopted.

Table 2.5 ARBM Parameters

Parameter	Adopted Values	Initial Values
Storage Capacities		
Impervious (IMP)	0.50	0.0
Interception (ISC)	1.00	0.0
Depression (DSC)	1.00	0.0
Upper soil (USC)	25.00	20.00
Lower soil (LSC)	50.00	40.00
Infiltration		
Dry soil sorptivity (SO)	3.00	
Hydraulic conductivity (K0)	0.33	
Lower soil drainage factor (LDF)	0.05	
Groundwater recession;		
constant rate (KG)	0.94	
variable rate (GN)	1.00	
Evapo-Transpiration		
Proportion of rainfall intercepted by vegetation (IAR)	0.70	
Max potential evapo-transpiration;		
upper soil (UH)	10.00	
lower soil (LH)	10.00	
Proportion of evapo-transpiration from upper soil zone (ER)	0.70	
Ratio of potential evaporation to A class pan (ECOR)	0.90	

Table 2.6 Rafts Surface Runoff Routing Parameters

Parameter	Value
Impervious surface roughness	0.015
Pervious surface roughness	0.040
Non-linearity coefficient (default) (1)	0.285

ILSAX

RAINFALL LOSS RATES

The Ilsax program incorporates the Horton's infiltration equation to determine rainfall losses occurring on pervious surfaces. Ilsax also requires that a catchment soil type and antecedent moisture condition be specified.

The rainfall loss parameter values in Table 2.7 shall be adopted.

Table 2.7 Ilsax Rainfall Loss Parameters

Parameter	Value
Impervious (paved) depression storage	1 mm
Pervious (grassed) depression storage	5 mm
Soil type	3.0
AMC	3.2

TIME OF CONCENTRATION

The procedure to calculate the time of concentration for sub-catchment pervious runoff shall be that specified for overland flow in Section Time of Concentration.

The time of concentration for all impervious areas should be set at 6 minutes.

RORB

The Rorb calibration analysis was not conclusive using the recommended runoff coefficient of 45%. Therefore, the following parameters should be used with caution when modelling ungauged catchments in the ACT.

Gauged catchments should be calibrated against recorded storm events using the runoff coefficient as the calibration parameter.

RAINFALL LOSS RATES

The Rorb model utilises a constant loss rate for impervious areas and an initial loss followed by a runoff coefficient or constant (continuing) proportional loss rate for pervious areas.

The rainfall loss parameters in Table 2.8 shall be adopted for pervious areas.

Table 2.8 Rorb Pervious Area Rainfall Loss Parameters

Parameter	Value
Initial loss	10 mm
Runoff coefficient	45%

SURFACE RUNOFF ROUTING

The Rorb runoff routing method is based on the storage-discharge relationship,

$S = 3600kQm$

The dimensionless coefficient, m, is a measure of catchment non-linearity with a value of 1.0 implying a linear catchment. The dimensionless empirical coefficient, k, is the product of two factors, kc and kr. The factor kr is a dimensionless ratio called the relative delay time applicable to an individual reach storage and kc is an empirical coefficient applicable to the entire catchment and stream network.

The runoff routing parameters in Table 2.9 shall be adopted.

Table 2.9 Rorb Runoff Routing Parameters

Parameter	Value
m (adopt default)	0.8
kc (adopt default equation)	$A^{0.5}$ (1)

A = catchment area (km2)

WATER BOUNDED NETWORK MODEL (WBNM)

RAINFALL LOSS RATES

The WBNM program offers a choice between two approaches to rainfall loss estimation. They are the initial/continuing loss model and the initial/proportional loss model. Due to a lack of information on proportional losses in Canberra, the initial/continuing loss model shall be used for both urban and rural catchment in the ACT with the recommended values given in Table 2.10

Table 2.10 WBM Rainfall Loss Values

Catchment	Initial Loss (mm)	ARI				
		2	5	10	20	≥50
		Continuing Loss (mm)				
Rural	0	3.6	3.3	2.8	1.7	1.0
Urban (30% urbanised)	0	2.5	2.3	1.9	1.2	0.7

SURFACE RUNOFF ROUTING

The values of parameter C in Table 2.11are recommended for use with the initial/continuing loss model for modelling ungauged catchments.

Table 2.11 WBMN Parameter C Values

No. of Sub-catchments	Parameter C
1	1.14
≥ 4	0.90
Excavated earth	0.3
Concrete lined	0.2

For non-linear channel routing, the recommended values for the watercourse factor, *WCFACT,* are given in Table 2.12

Table 2.12 WBMN Parameter C Values

Watercourse Type	WCFACT
Natural Channel	0.6
Gravel bed with rip-rap	0.4
Excavated earth	0.3
Excavated earth	0.2

OTHER METHODS AND MODELS

The use of other propriety hydrological methods or models will not be permitted without prior approval from Roads ACT.

To obtain approval, the Designer must demonstrate, to the satisfaction of Roads ACT, that a particular method or model is appropriate for ACT conditions. One of the following procedures shall be used to calibrate the method or model and determine appropriate assumptions and parameter values for the estimation of major and minor system design flows;

- calibration to the current flood frequency rating curves for the Giralang, Mawson, and Curtin catchments
- comparison with the Rational Method or one of the rainfall/runoff models described herein.

Flood frequency curves and calibrated model data sets for the Giralang, Mawson, and Curtin catchments may be obtained from Roads ACT.

The Designer shall submit a report to Roads ACT giving full details of the method or model to be used including all assumptions made, recommended

parameter values, and tabulated flow comparisons for major and minor system ARIs.

2.7 The standards required by the National Capital Authority, for roads, are to be complied with.
Major cutoff drain shall be design using the following guidelines.

PRIMARY OUTLETS

Provision shall be made to discharge flows up to and including 100 year ARI.

Design flows shall normally be discharged to a designated overland flow path via an outlet pipe or a spillway chute. Discharge points shall be provided at intervals not exceeding 600 m.

Where outlet pipes are provided, care shall be taken in the design to ensure that the entire 100 year ARI flow from the cut-off drain can be transferred to the outlet pipe. Inlet screening shall be provided to minimise the likelihood of blockage of the outlet from large debris.

Spillway chutes shall be stabilised to prevent scour. For supercritical flows, energy dissipation measures shall either be incorporated along the chute or provided at the point of discharge to the overland flow path.

RELIEF SPILLWAYS

Subdivision layouts should be planned to minimise the potential for property damage resulting from possible overflows from cut-off drains.

Relief spillways shall be provided at regular intervals to discharge flows in excess of the cut-off drain capacity or in the event of blockage of the drain or primary outlets.

3.1.2 Relief spillways shall be designed for a minimum capacity of 100 year ARI and discharge to designated overland flow paths.

Where overland flow paths are not available, the number of relief spillways shall be increased to avoid concentration of discharge and so minimise potential property damage. The Operating Authority shall be advised of such instances, and the proposed spillway locations submitted for consideration prior to completing final designs.

Relief spillways shall be stabilised to prevent scour and provided with adequate energy dissipation measures for supercritical flow.

GRADES

LONGITUDINAL

Minimum
Longitudinal grades shall not be less than 0.5% to minimise the likelihood of ponding and siltation within the drain.

Maximum
The maximum longitudinal grade shall be selected such that the average flow velocity in the drain does not exceed the following values under any operating conditions;

- 2 m/s for unlined drains
- 4 m/s for lined drains

SIDE SLOPES
The maximum side slopes of the cut-off drain invert section shall be;

- **slope in fill:** 1 in 2
- **slope in cut:** earth 1 in 2
  rock 1 in 0.25

MAINTENANCE

ACCESS CRITERIA

Cut-off drains shall be designed to allow for ease of maintenance, including ready access for maintenance machinery.

In general, cut-off drains shall be designed so that mechanical grass cutting equipment (ie. motor mowers or tractor mounted mowers) can be used to control grass and weed growth. Maintenance of the drain cross section should be possible using conventional earthmoving equipment such as backhoes, front-end loaders, and trucks.

Where conditions do not permit ready access, cut-off drains shall be designed for minimum maintenance by providing such measures as concrete lining or stone pitching of the drain.

ACCESS TRACKS

An all weather access track with a minimum width of 3.5 m shall be provided.

The access track shall be designed with the cross fall into the slope. The cross fall shall be within the following limits;

- 3% minimum
- 10% maximum

The preferred location for the track is on top of the drain embankment. However, in some instances it may be preferable to locate the track on the downstream side of the embankment.

Adequate scour protection shall be provided for the track. For longitudinal gradients exceeding 10%, the track should be surfaced with one of the following;

- two coat seal
- reinforced concrete
- unit paving
- bitumen stabilised decomposed granite gravel.

Where access tracks have insufficient width to allow maintenance vehicles to pass, pull over bays shall be provided at a maximum spacing of 250 m.

ACCESS POINTS FROM URBAN AREA

Access from the urban road network via feeder roads, culs-de-sac, pedestrian ways, or floodways shall be provided at intervals not exceeding 500 m.

Access points shall have a minimum width of 3.5 m to allow unconstrained access for maintenance vehicles. Structures should not be allowed to impinge on the access.

Provision shall be made to prevent access to the cut-off drain by unauthorised vehicles.

Hard surfacing shall be provided for access points steeper than 10% in accordance with Section Access Tracks.

CROSSING POINTS

Crossing points may be required to gain access to areas above a cut-off drain. The Designer shall refer to the Operating Authority for the requirement and location of crossing points.

Generally, the crossing may be designed at-grade where side slopes are not steeper than 1 in 6. The crossing point shall be provided with a hard surface to delineate the point as a crossing, provide scour protection, and prevent damage to the embankment and drain by vehicles.

Where cross sectional side slopes are steeper than 1 in 6, the crossing should be formed using a culvert or bridge crossing with a minimum capacity of 100 year ARI. Adequate scour protection of the drain shall be provided on both sides of the culvert.

3.1.3 Grated pits shall not be used. Where it is necessary for grated pit to be used, approval to be sought from Roads ACT. The grated pit shall be assumed to have zero inlet capacity.

3.2.3 No grated pit in the pavement is allowed. Where it is necessary for grated pit to be used, approval to be sought from Roads ACT.

3.4.1 In managing the surface flows from a road, the impact on the destination of the surface flows is to be assessed and actions determined to minimise any effects of these flows.

Major traffic routes (Arterials and Sub-Arterials) shall remain at least partially operational during major storm events. Where drainage from major traffic routes is connected to urban drainage designed for a lower ARI, consideration shall be given to making the drainage for the two systems compatible.

MAJOR DRAINAGE CROSSINGS

Crossings (eg. bridges, culverts, etc) over major floodways and natural waterways shall be designed in accordance with TRIS 07 Bridges and Related Structures.

A minimum freeboard of 0.6 m shall be provided at the upstream face of the crossing to minimise potential damage from floating debris.

Table 3.2 Surface Flow Criteria for Roads
(Source: adapted from Queensland Road Drainage Design Manual, 2010)

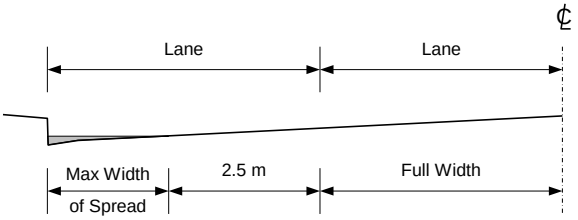
3.4.2

Criteria	Surface Flow Limit
Minor System Flow	
Two through lanes in the same direction	One full clear lane + minimum 2.5 m clear width in the other lane
One lane plus parking lane	One full lane clear
One lane	Minimum 3.5 m clear width in the lane
At medians	Minimum 2.5 m clear width in the traffic lane
At turn lanes	Minimum clear width of 3.5 m in the lane
At pedestrian crossings	$W \leq 0.45$ m (1 year ARI flow)
At intersection kerb returns	Clear turning width of 3.5 m
50 year ARI Flow	
Major Traffic Routes	One full lane clear
Major System Flow	
Where floor levels of adjacent buildings are above road level	Total flow contained within road reserve. Peak water levels at least 300 mm below floor level of adjacent buildings (i.e. freeboard of at least 300 mm)
Where floor levels of	Water depth to be limited to 50 mm above

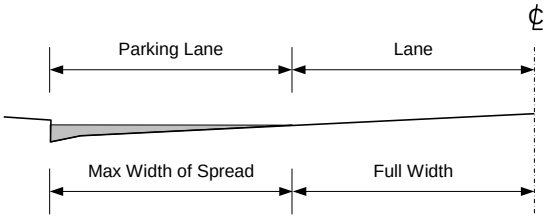
adjacent buildings are less than 350 mm above top of kerb.	top of kerb.
Where fall on footpath towards kerb is greater than 100 mm;	Water depth to be limited to top of kerb in conjunction with a footpath profile that prevents flow from the roadway entering onto the adjacent property.
Where fall on footpath towards kerb is less than 100 mm;	Above depths shall be measured from the theoretical top of kerb.
Where no kerb is provided.	
Pedestrian safety a) no obvious danger b) obvious danger	 $V.D < 0.6$ m^2/s $V.D < 0.4$ m^2/s
Vehicular safety	Maximum energy level of 300 mm above roadway surface for areas subject to transverse flow.

Notes:

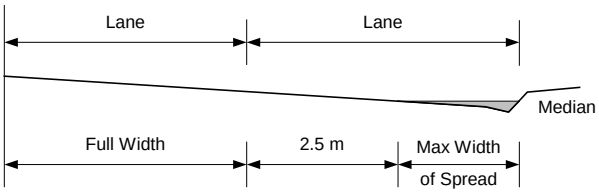
(1) W = flow width on road from kerb gutter invert
(2) flow width criteria applies to each direction of traffic flow
(3) D = flow depth on road at kerb gutter invert
(4) V = average longitudinal flow velocity
(5) the flow affected area shall be taken as that where the flow depth is greater than 3 mm
(6) lane includes acceleration or deceleration lanes > 60 km/h and any parking lane that has the potential in the future to become used as a through lane for full or part time.



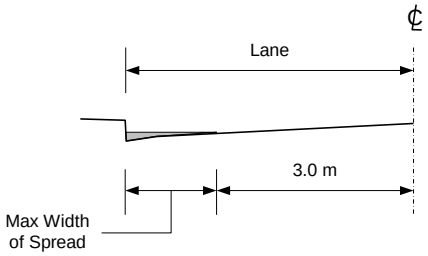
(a) Two Through Lanes in the Same Direction



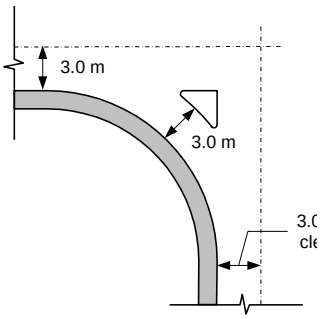
(b) One Lane + Parking Lane



(c) At Medians



(d) One Lane



(e) Turn Lanes and Intersection Kerb

Figure 3.5 Allowable Flow Widths on Roadways – Minor System ARI
(Source: adapted from Queensland Road Drainage Design Manual, 2010)

PROTECTION DRAINS

Carriageways in cuttings and cut batters should be adequately protected from runoff originating beyond the limits of the road. This protection will generally take the form of cut-off drains or dished gutters. The general requirements for cut-off drains as set out in Section 8 shall be observed for these protection drains.

CROSS DRAINAGE

Flows up to and including 100 year ARI shall not be permitted to flow onto major traffic routes from adjacent land.

UNDERPASSES

Pedestrian underpasses on roadways shall be provided with sufficient longitudinal grade to facilitate free drainage wherever possible.

Where a self-draining underpass is not possible, the underpass drainage system shall be designed for a 20 year ARI capacity.

Public safety considerations preclude the use of grated sumps or grated strip drains in underpasses.

Where an underpass is part of an engineered waterway, the free draining underpass drainage system shall be designed for a 5 year ARI. The level of footpaths and cycleways shall be above the 2 year ARI flood level in the engineered waterway. A floodway advisory sign shall be provided on each approach to the underpass.
The following Standard Drawings developed by Roads ACT are to be used where applicable.

TITLE	NUMBER	REV	DATE
Pipe Junctions	ST-0001	02	March 1998
Pipe Details	ST-0002	02	March 1998
Sump Inlets on Kerbs and Gutters	ST-0011	04	March 1998
Type R and QS Sumps	ST-0012	02	March 1998
Plantation and Grated Sumps	ST-0013	02	March 1998
1050 ND Manholes	ST-0014	02	March 1998
Special Chambered Manholes	ST-0015	02	March 1998
Surcharge Structures	ST-0016	02	March 1998
Structures - Miscellaneous Details	ST-0017	02	March 1998
Pipe Connections to Structures	ST-0018	02	March 1998
Multiple Type R Sumps	ST-0019	01	March 2002
Pipe Culverts 300 - 675 Dia - Endwalls	ST-0021	02	March 1998
Pipe Culverts 750 - 1200 Dia - Headwalls	ST-0022	02	March 1998
Precast Box Culverts - Endwalls	ST-0023	02	March 1998
Precast Box Culverts - Headwalls	ST-0024	02	March 1998
Floodway Low Flow Provisions	ST-0025	02	March 1998
At-Grade Floodway Crossings	ST-0026	02	March 1998
Minor GPT Layout - Parallel to Floodway	ST-0031	02	March 1998
Minor GPT Layout - Perpendicular to Floodway	ST-0032	02	March 1998
Major GPT Layout	ST-0033	02	March 1998
GPT Trash Racks	ST-0034	02	March 1998
Floodway Advisory Sign	ST-0041	02	March 1998

4.1

4.2 Roads Act and Department of Environment, Climate Change, Energy and Water (DECCEW) are responsible for the management of stormwater related issues.

GAP FLOW

4.5.3 Gap flow shall be determined as follows

$$Q_{gap} = Q_{100} - Q_{B/Minor}$$

Where $Q_{B/Minor}$ shall be the capacity of the underground system with assumed 50% blockage of all available inlet structures.

DESIGN AVERAGE RECURRENCE INTERVALS

The ACT stormwater system is designed on the basis that the cost/benefit of providing a certain standard of flood protection varies with the type of development.

The minor drainage system design ARI shall be selected in accordance with Table 4.11.

Table 4.11 Minor System Design ARI

Type of Development	ARI (Yrs)
Parliamentary Area (bounded by Lake Burley Griffin, Flynn Drive, State Circle (including Capital Hill), Brisbane Avenue & Bowen Park)	20
Town Centres (eg. Civic, Woden, Belconnen, Gungahlin and Tuggeranong)	20
Group and Neighbourhood Shopping Centres (eg. Pearce, Mawson, Torrens, Kippax and Kingston)	10
Industrial areas (eg. Fyshwick, Mitchell and Hume)	10
Service Trades areas (eg. Belconnen and Phillip)	10
Urban Neighbourhood development (except in designated preserved environment areas)	5

4.5.4 The major drainage system shall be designed to ensure that all leased land is protected against inundation from flood flows up to and including 100 year ARI.

The design analysis carried out by the Designer shall take into account the possibility of property damage or danger to life that might occur in specific situations. The design storm ARI recommended or adopted in such cases shall be the subject of specific advice and reports from the Designer to the Operating Authority. For example, the design ARI for cycleways and bridges should be consistent with AUSTROADS Guide to Bridge Technology, AS 5100, TRIS Bridge Standards and AUSTROADS Guide to Road Design Part 6A.

4.6 The design of the underground drainage system is an important element of the overall drainage system as the two areas meet within the road reserve and so consideration of the development area drainage is needed.

STORMWATER RETICULATION DESIGN CRITERIA

Pipes shall be designed by a "hydraulic grade line" (HGL) method using appropriate pipe friction and drainage structure head loss coefficients. Drainage structure head loss coefficients may be obtained from the various established researches or Figure 4.9 of AGRD Part 5.

4.6.3 Actual pipe diameters, as opposed to nominal pipe diameters, shall be used for hydraulic calculations.

Pipes shall be sized using the design charts in AS2200. The charts based on the Colebrook-White equation shall be used for sizing pipes designed to flow full under pressure. The charts based on the Manning's equation shall be used for sizing pipes designed to flow full but not under pressure. Appropriate pipe roughness values should be selected from Table 4.12.

Table 4.12 Pipe Roughness Values

Pipe Material	*n*	*k*
Spun Precast Concrete	0.011	0.3
Fibre Reinforced Cement	0.010	0.15
Vitrified Clay	0.013	0.6
UPVC	0.009	0.06

STORMWATER RETICULATION LOCATION AND ALIGNMENT

Stormwater pipelines should be located on the high side of road reserves to permit relatively short service tie connections to adjacent properties.

Acceptable alignments shall be in accordance with Table 4.13

Curved pipeline alignments are preferred on curved roadways. However, where there are significant advantages, eg culs-de-sac or narrow street verges, straight alignments may be permitted

In selecting pipeline locations, it is necessary to consider manhole and sump locations. Sump and manhole location preferences are outlined in Table 4.13 respectively.

Table 4.13 Alignments within Roadway Reserves

Diameter (mm)	Alignment (m)
225 to 675	0.6 behind kerb line
750 to 1200	within median strip or centre line of roadway

Pipelines are not allowed to be located under footpaths. If this cannot be avoided the ACT Government shall be consulted for principle approval.

The minimum pipe size shall be 300mm diameter for pipes draining surface inlet structures.

4.6.4 No Reduction in pipe size for the downstream pipe will be accepted without prior approval from Roads ACT.

Maximum spacing of sumps or maintenance holes shall be in accordance with Table 4.14

Table 4.14 Maximum Sump Spacing

Diameter (mm)	Maximum Sump Spacing (m)
225 to 450	100
525 to 900	150
1050 to 1200	300

CLEARANCE FROM OTHER SERVICES

Minimum clearances have been established to reduce the likelihood of damage to stormwater pipelines or other services, and to protect personnel during construction or maintenance work.

Under no circumstances shall stormwater pipelines be;

- cranked to avoid other services or obstacles
- located longitudinally directly above or below other underground services in the same trench

Where a stormwater pipeline crosses or is constructed adjacent to an existing service, the design shall be based on the work-as-executed location and level of that service. The design documents shall direct the Contractor to verify the

location and level of the existing service prior to constructing the stormwater pipeline in question.

Minimum clearances between stormwater pipelines and other underground services shall be in accordance with Table 4.15.

Table 4.15 Minimum Clearances

Service	Clearance (mm)
Horizontal	
All services	600
Vertical	
Sewers	150
Water mains	75
Telecommunications	75
High Pressure Gas	300
Low Pressure Gas	75
High Voltage Electricity	300
Low Voltage Electricity	75

Where a stormwater pipeline will be located within close proximity to another service, the Designer shall ensure that the requirements of the ACT Government and Service Authority are met.

Stormwater pipelines shall be designed such that maintenance activities can be performed without the risk of inadvertent damage to the assets of other Authorities.

STRUCTURAL DESIGN OF PIPELINE

MINIMUM DESIGN SERVICE LIFE

Pipelines and culverts shall be designed for a minimum effective service life of 50 years.

MINIMUM DEPTH

Stormwater pipelines shall be deep enough to serve the whole of the adjacent block(s).

Minimum cover over pipelines shall be 0.6 m from top of pipe to finished surface level. For pipelines under road pavements, the required cover shall be measured from top of pipe to pavement subgrade level. Where this is not possible, a higher class pipe shall be used.

In addition to the above, the pipes are required to be designed to take account of the loadings during construction that may be applied.

MAXIMUM DEPTH

The maximum depth of stormwater pipelines to invert level shall be 6m.

In special cases (eg. for a short length of pipeline through a ridge), approval must be obtained from the Act Government to exceed this limit.

CONNECTION TO STRUCTURES

Where pipes are connected to rigid structures or are embedded in concrete, flexible joints shall be provided to minimise damage caused by differential settlement. Connections shall be constructed in accordance with Standard Drawing ST-0018.

CURVED PIPELINES

Curved stormwater pipelines may be utilised wherever there are significant

advantages in their use. Ad hoc curving of pipelines to avoid obstacles such as trees, power poles, gas mains etc. is not permitted. Curved pipelines should be positioned to follow easily identifiable surface features, eg. parallel to a kerbline.

Curved pipelines shall have a constant radius.

Curved pipelines are permitted provided they are;

- in the horizontal plane only (no vertical curves)
- in one direction only between successive structures (no reverse curves)

Curved pipelines shall be achieved as follows;

- *Curves formed by using rubber ring or flush jointed pipes,*
  the curve shall be achieved totally within the pipe joint system so that the rubber ring or external proprietary band remains effective. Because of different pipe joint performances, the maximum deflection angle shall be as recommended by the Pipe Manufacturer

- *Curves formed by using splayed pipes,*
  splayed pipes may be used to construct a curved pipeline provided that the curve is totally formed by the splays

  splayed pipes shall be either;
  - factory formed (preferred), or
  - field formed by cutting standard pipes with an approved cutting device

Design drawings shall show the following curve information;

- centreline radius
- pipe type (normal or splayed)
- effective length of individual pipes (if other than standard length)
- type of jointing

The Designer shall submit documentation to show that the above details are within the Pipe Manufacturer's specifications.

BRANCH CONNECTIONS

Pipeline junctions should occur within a sump, manhole, or special structure. Branch connections may be permitted provided that adequate structural strength can be achieved at the junction.

Allowable sizes of branch connections into pipelines of 450 mm to 1200 mm diameter are shown on Standard Drawing ST-0001.

A manhole shall be constructed on the branch pipeline within 20 m of the branch connection.

Entry angles for branches shall be between 45° and 90° to the main pipeline in horizontal direction only (refer to Figure 4.12). Vertical entry will not be permitted.

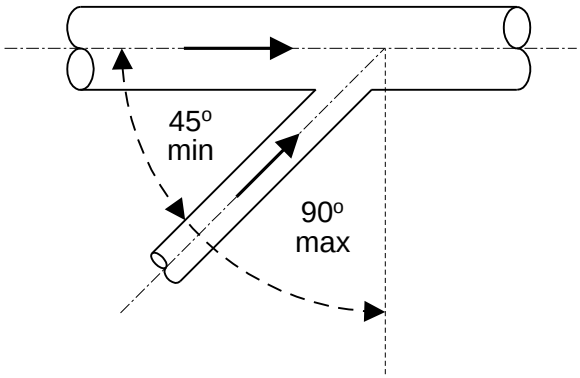


Figure 4.12 Permissible Entry Angles for Branch Connections

DEAD END PIPELINES

A dead end pipeline shall be constructed on a straight alignment and shall not be greater than 50 m in length.

Dead end pipelines shall drain directly to a manhole or sump. Connection of a dead end pipeline to another stormwater pipeline by a branch connection or slope junction will not be permitted.

STORMWATER SUMPS

GENERAL

Stormwater sumps shall efficiently conduct storm flows from the surface to the underground pipe system. Standard sizes and shapes should be used to achieve economy in construction and maintenance.

When selecting and locating sumps, consideration shall be given to hydraulic efficiency; vehicle, bicycle and pedestrian safety; debris collection potential, and maintenance problems.

Deflector slabs will not be permitted.

CONSTRUCTION

Sumps shall be constructed so that they are structurally sound and do not permit ingress of water through the walls or joints. Sumps shall be resistant to erosion and corrosion. Where necessary, special corrosion resistant cement shall be utilised.

Sumps shall be constructed from;

- in-situ concrete or
- precast concrete.

Alternative materials for sumps may be acceptable. Proposals for the use of other materials shall be referred to the ACT Government for consideration.

STANDARD SUMP TYPES

Types of sumps for general use are:

Type R Sump

This is a double sump suitable for pipe depths up to a maximum of 3.5 m. All kerbside sumps at low points and on-grade shall generally be type R sumps.

Refer to Standard Drawing ST-0012 for details.

Type QS Sump

This is a single sump suitable for pipe depths up to a maximum of 1.8 m.

A QS sump may be used;

- at changes in direction where entry of water is not essential (ie. side entry may be sealed)
- in tight radius kerb returns where the length of a type R sump is inappropriate
- as a plantation sump.

Refer to Standard Drawing ST-0012 for details.

Plantation Sump

This may be either a type QS or type R sump with a single or double-sided concrete apron. Plantation sumps shall be used in medians or grassed areas.

Refer to Standard Drawing ST-0013 for details.

Grated Sump

This type of sump blocks easily and should be avoided wherever possible. The use of grated sumps for roadway or underpass drainage is not permitted except in laneways with narrow verges where a type R or QS sump would conflict with other services.

Single and double-grated sumps may be used in paved pedestrian areas for pipe depths up to a maximum of 1.0 m, subject to the following conditions:

- the sump catchment area is minor
- grates shall conform to the requirements of AS 3996
- the inlet capacity of grated sumps shall be assumed to be zero in the design of the major drainage system (ie. allowance for 100% blockage)
- in the event of blockage of the inlets, the resulting depth of flooding shall not exceed 50 mm and a safe passage for overflow shall be provided
- light duty grates will not be permitted
- all grates shall be hinged and bolted.

Refer to Standard Drawing ST-0013 for details.

High Inlet Capacity

Where high inlet capacity is required, the preferred solution is multiple type R sumps placed side by side.

As an alternative to multiple type R sumps, special sumps may be designed and used.

The proposed sump arrangement for any location where high inlet capacity is required shall be submitted to Roads ACT for consideration.

Refer to Standard Drawing ST-0019 for details of multiple type R sumps.

Surcharge Sump

Surcharge sumps shall be provided;

- where branch pipelines connect to low flow pipelines in floodways
- where there are shallow points in the system to form an emergency overflow relief path in times of acute hydraulic overload or blockage of the pipe system.

The surcharge capacity of the sump shall be at least twice the total inflow to the sump to allow for partial blockage of the outlet during surcharge.

Refer to Standard Drawing ST-0016 for details.

LOCATION

The use of entry sumps within blocks is not acceptable where such sumps form part of the public stormwater system.

Kerb sumps for all roadways shall be located such that gutter flow widths do not exceed the surface flow limits specified in Table 3.2 and Figure 3.5.

All low points in road gutters shall be provided with sumps. When a low point occurs in an intersection kerb return, a type R sump should be placed at the low point. A type R sump shall be provided at one of the kerb return tangent points. Preferably, the type R sump should be positioned at the tangent point of the steepest street.

MAXIMUM SPACING

Maximum spacing of sumps shall be in accordance with Table 4.16.

Table 4.16 Maximum Sump Spacing

Diameter (mm)	Maximum Sump Spacing (m)
225 to 450	100
525 to 900	150
1050 to 1200	300

GUTTER FLOW

Gutter flow widths for KG, MLBK, & MKG kerbs shall be obtained from Figure 4.13 to Figure 4.15.

Flow widths have been obtained from full-scale tests carried out at the University of South Australia assuming a smooth hotmix surface with a Manning's 'n' of 0.014. The figures may also be used for a single coat seal surface with a Manning's 'n' up to and including 0.018.

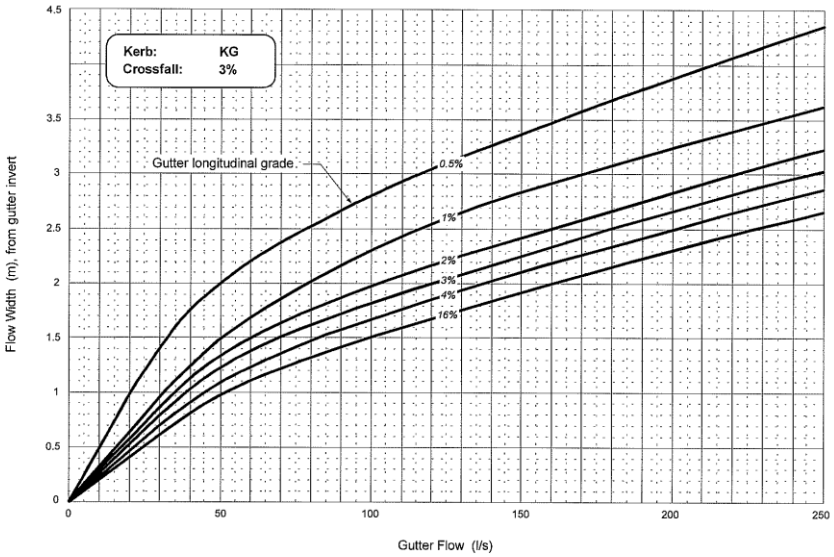


Figure 4.13 Gutter Flow Widths

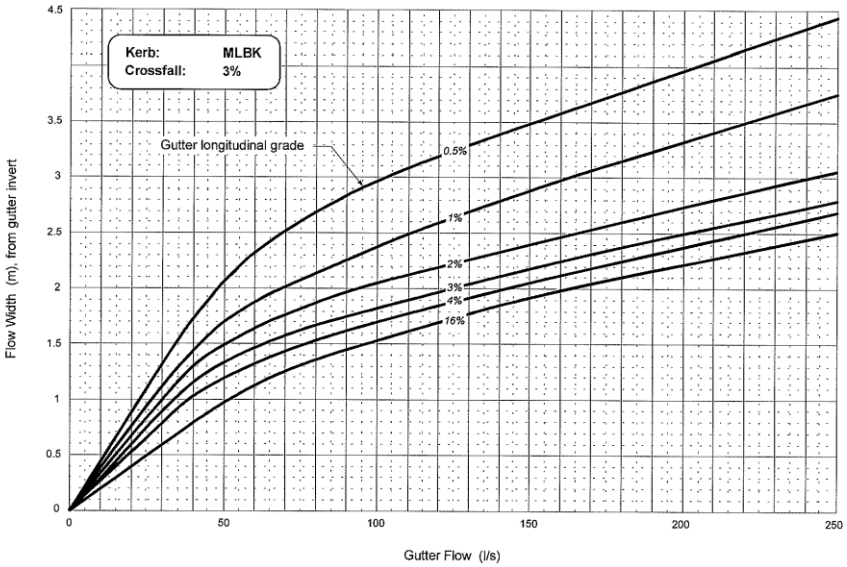


Figure 4.14 Gutter Flow Widths

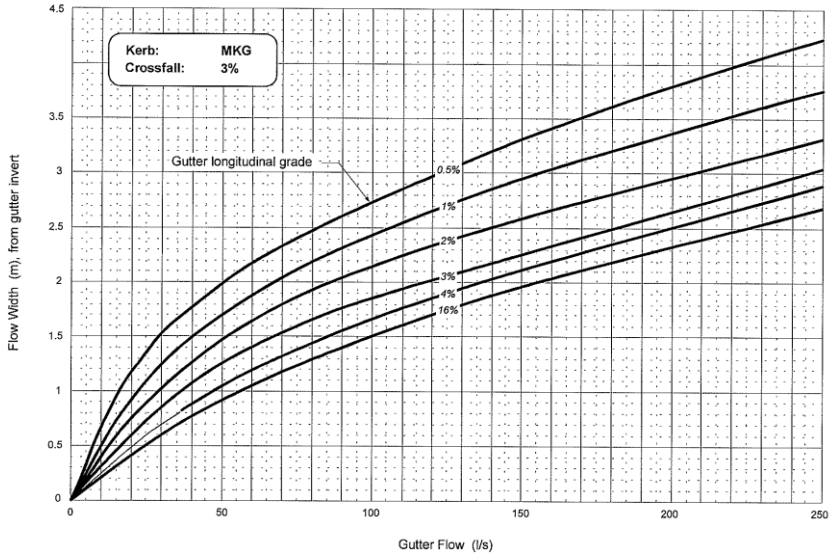


Figure 4.15 Gutter Flow Widths

INLET CAPACITY

Inlet capacities for on-grade and low point sumps on KG, MLBK, & MKG kerbs shall be obtained from Figure 4.16 to Figure 4.23 (includes multiple on-grade type R sumps on KG).

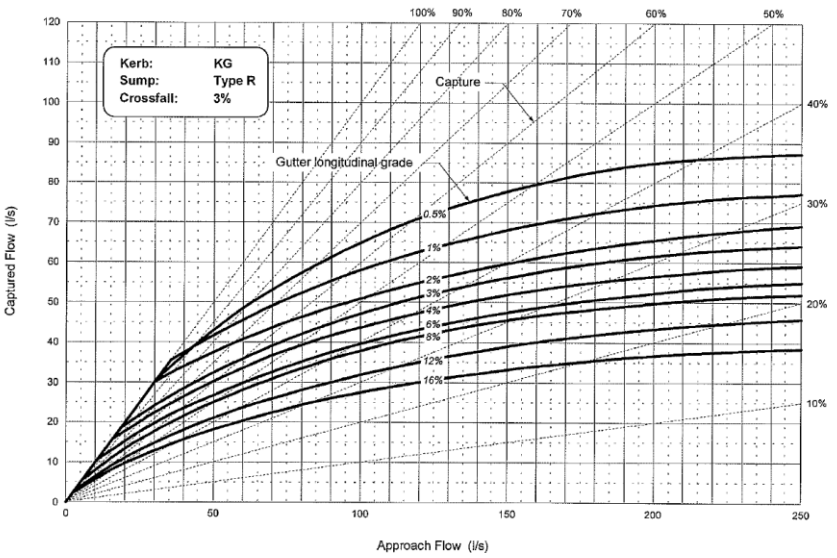


Figure 4.16: On-Grade Sump Inlet Capacities

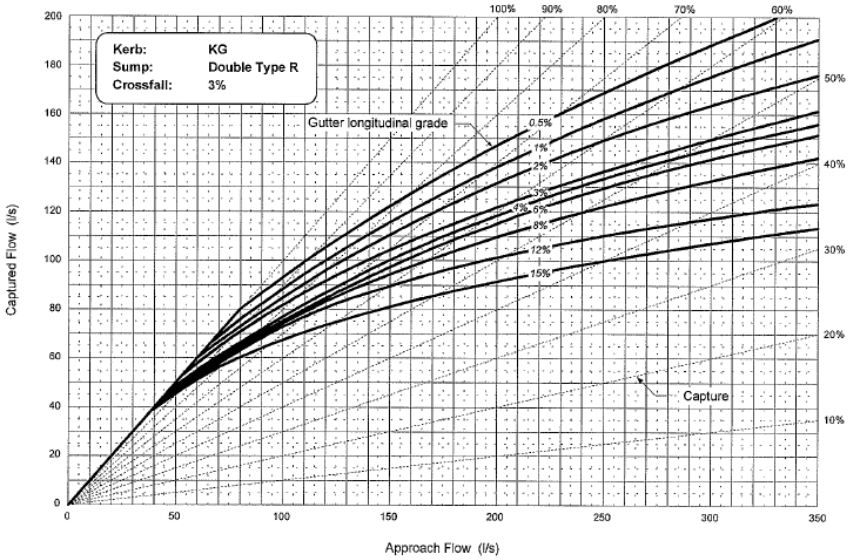


Figure 4.17: On-Grade Sump Inlet Capacities

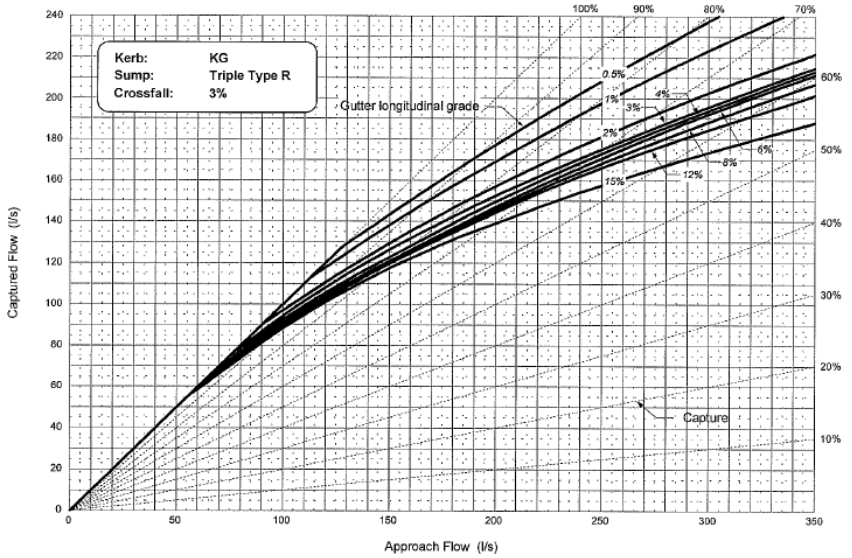


Figure 4.18: On-Grade Sump Inlet Capacities

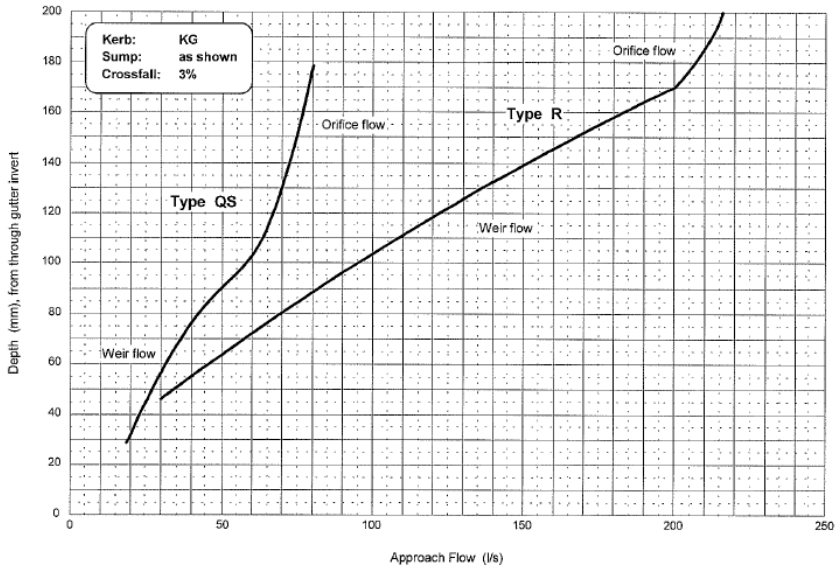


Figure 4.19: Low Point Sump Inlet Capacities

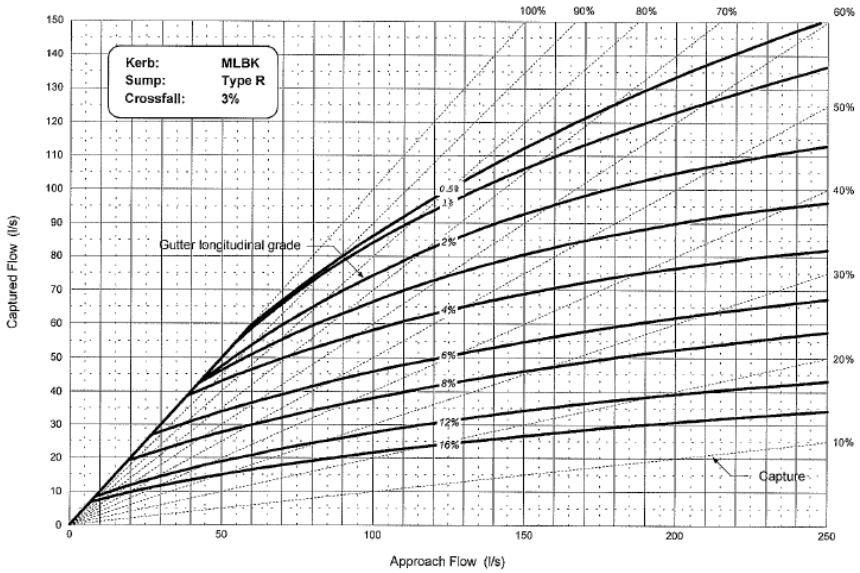


Figure 4.20: On-Grade Sump Inlet Capacities

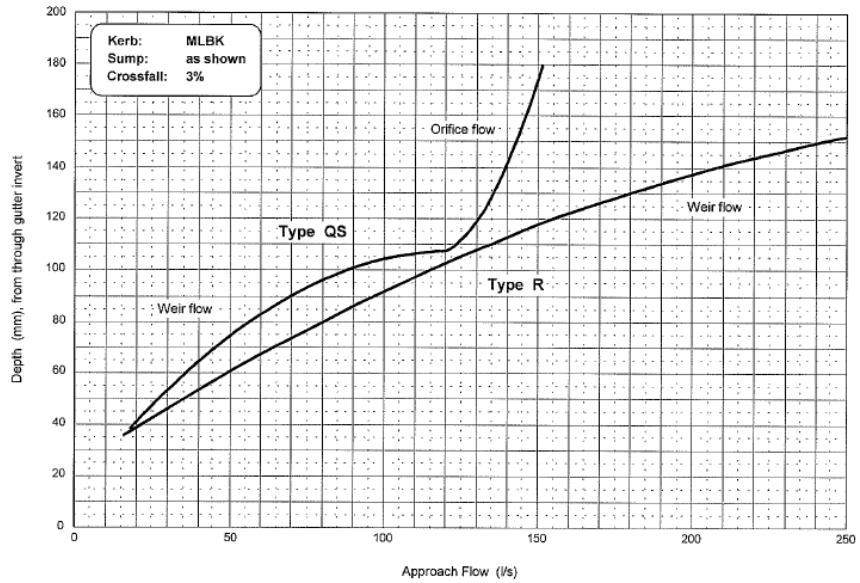


Figure 4.21: Low Point Sump Inlet Capacities

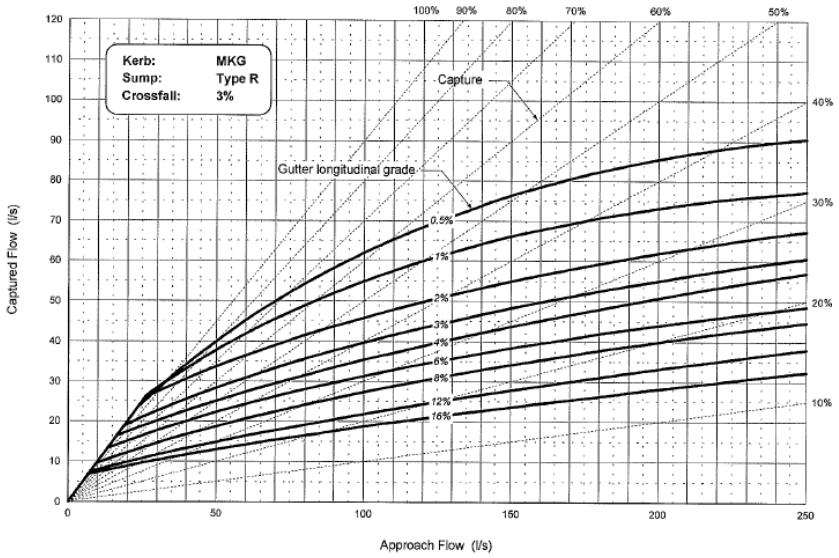


Figure 4.22: On-Grade Sump Inlet Capacities

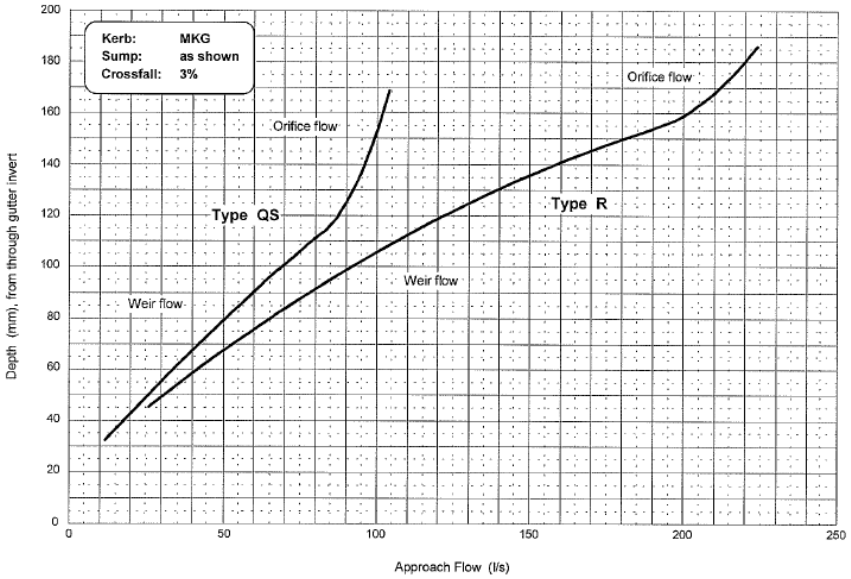


Figure 4.23: Low Point Sump Inlet Capacities

Sump inlet capacities have been obtained from full-scale tests as stated previously.

FALL THROUGH SUMPS

The fall through a sump on a pipeline not operating under a hydraulic head at maximum design flow shall be equal to or greater than the energy loss through the sump.

A minimum fall of 50 mm shall be provided through a sump (refer to Figure 4.24).

A 50 mm minimum fall shall also be provided for pipelines designed to operate under hydraulic head at maximum design flow.

Irrespective of these requirements, the pipeline grade shall not be reduced through the sump.

BENCHING

Sumps on New Pipelines

The base of the sump shall be formed to provide a constant fall to the outlet and to stop the ponding of water within the sump.

The invert of the benching shall have a minimum fall of 50 mm towards the outlet.

A minimum benching side slope of 1 in 50 shall be provided.

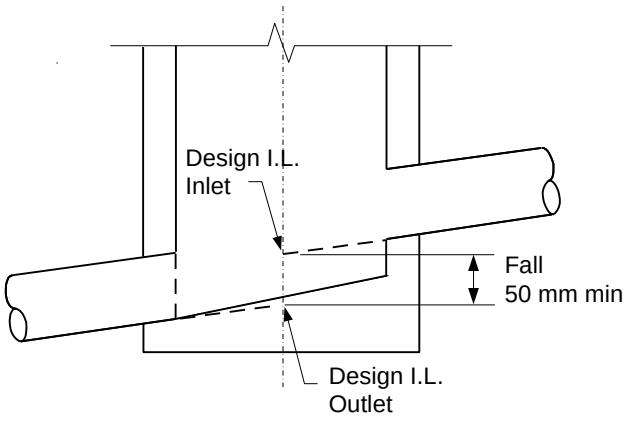


Figure 4.24 Minimum Fall Through Sump

Sumps on Existing Pipelines

The sump shall be benched to the full diameter (height) of the pipe for the full length of the sump. Refer to Figure 4.25 for details.

The top of the benching shall be sloped at a minimum side slope of 1 in 10.

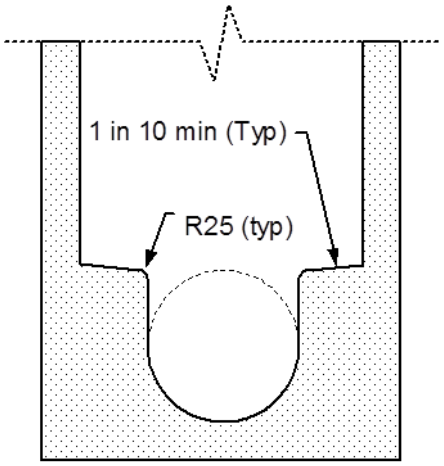


Figure 4.25 Benching for New Sumps on Existing Pipelines

SUMP COVERS

Standard Covers

Standard covers shall be reinforced concrete and not be subject to traffic loads or hydraulic surcharge.

It shall consist of a standard reinforced concrete seating ring and lid in accordance with Standard Drawing ST-0017.

Metal Access Covers

Covers that will be subjected to either internal or external loadings shall be in accordance with the latest edition of AS 3996.

The type of sump cover shall be selected according to the following criteria;

- trafficable area Class D
- non trafficable area Class C
- grated cover Class D

Access covers on surcharge structures (refer to Standard Drawing ST-0016) shall be bolted down with stainless steel bolts to secure the cover and the seating ring to the sump.

Cast iron covers shall be 'GATIC', or equal as approved in writing by Roads ACT.

Cover Levels

Sump covers shall be set at the finished cover levels given in Table 4.17.

Where finished surfaces are steeper than 1 in 10, the sump cover shall be level. An adjacent flat area shall be provided with sufficient space on which to place a removed cover.

Table 4.17 Cover Levels

Location	Cover Level
Paved Areas	Flush with finished surface
Footpaths and street verges	Flush with finished surface
Established plantations	Flush with finished surface
Elsewhere	Flush with finished surface

ABANDONED SUMPS

The preferred option for existing sumps to be abandoned is to exhume the sump and construct a straight through pipe.

However, if this is not possible, the sump shall be converted to a special chambered manhole (similar to Standard Drawing ST-0015) to permit access for maintenance. The sump shall be benched to the full diameter (height) of the pipe for the full length of the sump (refer to Figure 4.26). The top of the benching shall be sloped at a minimum slope of 1 in 10.

Under special circumstances, sealing of an existing sump below finished surface level without a manhole access will be considered for straight through pipelines or where the angle between the inlet and outlet pipes is greater than 120° (refer to Figure 4.26).

Written approval must be obtained from the ACT Government for the design of abandoned sumps prior to construction.

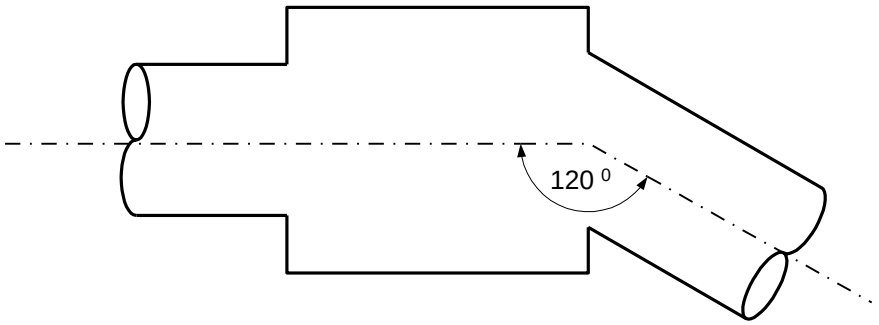


Figure 4.26 Permissible Pipe Angle for Sealing an Existing Sump

RETENTION OR DETENTION BASINS

4.7 Detention or Retarding Basins should be considered in conjunction with adjacent stormwater systems and developments. Consideration of combining basins to address development and roadside stormwater management is recommended.

This section should be read in conjunction with the Development Infrastructure Standards.

Retarding basin embankment slopes shall have a maximum batter of 1 in 8.

SUBSURFACE DRAINAGE

5 A subsurface drainage system must drain into a sump and the sump must be designed to accept these drains.

FLOODWAYS (AS CHANNELS)

6 The design of floodways (channels) in the roadscape should be considered with the surrounding stormwater system as this provides a link between the drainage system from the development areas and the road.

Floodway referred in this Section is a section of road that has been designed to be overtopped in relatively low ARI floods. This is not permitted in the ACT.

6.1 The ACT Government needs to be consulted should the use of this option is unavoidable.

CULVERTS

6.2 Culverts are to be designed to accommodate the design flows for the 100 year ARI storm.

Culverts greater than 1200mm x 900mm shall be designed for T44 loadings in accordance to TRIS 07 Bridges and Related Structures.

TREATING POLLUTANTS

7 Designers should also refer to ACTPLA Waterways, Water Sensitive Urban Design General Code for additional information on these treatments.

7.2 Criteria specified in the ACT Waterways – Water Sensitive Urban Design General Code are to be met.

GROSS POLLUTANT TRAP

GENERAL REQUIREMENTS

Unless otherwise directed by the Planning Authority, gross pollutant traps (GPTs) shall be provided at the downstream end of pipelines and engineered waterways that discharge into water pollution control ponds (WQCPs), urban lakes and receiving waters (eg. Murrumbidgee River) whenever the catchment area of the pipeline or engineered waterway exceeds 8 hectares.

GPTs provide initial water pollution control for WQCPs and urban lakes by removing litter, debris and coarse sediment from stormwater. Most GPTs will also provide some reduction in other pollutants. For example, trapping of coarse sediment may also provide:

7.3.4
- removal of particulate nutrients
- removal of trace metals, oil and grease
- reduction in bacteria
- reduction in dissolved oxygen demanding substances

All of the above substances can be partly bound to sediments, and will be removed along with the trapped sediment.

GPT TYPES

The most commonly used types of GPT in Canberra to date have been the 'Minor GPT' and the 'Major GPT' which consist of a concrete sediment basin with a fixed trash rack at the downstream end of the basin. However, in recent years there have been numerous proprietary devices developed for trapping gross solids that may be suitable for use in Canberra. To help distinguish Minor and Major GPTs from the newer proprietary traps available, the former shall now be referred to as Minor and Major DUS GPTs. The term GPT shall refer to any device designed to trap gross solids.

Selection of suitable devices depends on many factors including catchment size, pollutant load, type of drainage system and cost. Table 7.5 provides an overall classification of the types of GPT that may be permissible for use in Canberra, and the range of catchment areas for which they are suitable.

The Australian eWater CRC (Co-operative Research Centre) provides guidance on the installation of these and other water sensitive treatments.

Proposals for the use of GPT devices other than DUS GPTs shall be referred to the Operating Authority for consideration. Only devices capable of being maintained with conventional maintenance equipment will be considered.

Table 7.5 General Classification of GPTs

Group	Description and Function	Catchment Area Range	Purpose-built or Proprietary
Floating debris traps (booms)	Litter capture on permanent water bodies	> 200 ha	Proprietary
Trash racks & litter control devices	Hard or soft litter capture devices for pipelines and engineered waterways	2 – 400 ha	Purpose built
Sediment traps	Sediment removal only, on pipelines	> 200 ha	Purpose built
DUS GPTs	Sediment and litter capture for pipelines or engineered waterways	5 – 2000 ha	Purpose built
Proprietary devices	Range of devices, mainly for pipelines	2 – 40 ha	Proprietary

LOCATION

GPTs shall be located either;

- within the pipe system with the structure below finished surface level, or
- within an engineered waterway with the structure at or below finished surface level

SIZING CRITERIA

GPTs shall be designed to retain all trash and debris and a percentage of coarse sediment transported by dry weather base-flow and flow events up to and including 1 year ARI.

DUS GPTs shall be sized in accordance with the methods outlined in Section DUS GPT Design Method. The surface area of the sediment trap shall be sized to retain 70% of grain sizes greater than or equal to 0.04 mm. The trap volume shall be based on an average cleaning frequency of 2 per annum.

Approved proprietary traps shall be sized in accordance with the trap Manufacturer's specifications.

MAINTENANCE

GPTs shall be designed to facilitate maintenance especially in respect of removal of silt and debris. Designs shall be based on cleaning operations being undertaken with conventional plant and equipment. The designer shall refer to Roads ACT for other type of GPTs.

DEWATERING

GPTs shall be designed to allow dewatering of supernatant water within the trap by gravity drainage or pumping to a downstream waterway or WQCP.

Dewatering facilities shall be;

- designed for ease of maintenance
- screened to minimise the likelihood of pump or pipe blockage by sediment and debris
- located such that maintenance equipment operating within the trap will not be obstructed.

DUS GPT DESIGN REQUIREMENTS

Major DUS GPT

Major DUS GPTs shall conform to the general requirements of Standard Drawing ST-0033 and shall incorporate the following specific features;

(A) TRASH RACK

- grill spacing shall be capable of retaining a 375 ml metal drink container
- trash racks shall be sized to operate effectively during flows up to and including the 1 year ARI
- trash racks shall be structurally stable when overtopped by flood events up to 100 year ARI or when fully blocked
- trash racks shall be able to withstand impact from a piece of debris weighing 500 kg and travelling at 3.0 m/s
- trash racks shall conform to Standard Drawing ST-0034
- panel widths may be either 2.8 m or 4.8 m

(B) SEDIMENT TRAP

- the minimum plan dimensions of the trap shall be 6 m x 12 m
- the trap shall be dimensioned such that the length to width ratio is between 2 and 3 and the width is a multiple of 3.0 m or 5.0 m. The width shall be sized for a minimum of two trash rack panels
- a base-flow bypass shall be provided around the sediment trap and trash rack to facilitate access for cleaning. The bypass shall operate under gravity and have a minimum capacity of 1.5 l/s per km^2 of catchment area
- a sediment drying area with a minimum area equal to 1.5 m^2 for each cubic metre of trap volume shall be provided. The area shall be surfaced with 300 mm of compacted gravel
- the sediment trap floor shall be graded to a low point to facilitate dewatering of the trap
- the width of base-flow discharge over the trash rack weir wall and dowstream apron shall be kept to a minimum, preferably confined within a single trash rack panel
- the minimum level of the top of the trash rack side wall returns shall be the greater of the 1 year ARI flow level in the sediment trap when the trash rack is fully blocked or 300 mm above the top of the trash rack. The top of the return walls shall slope upward from the trash rack to finished ground level at a minimum slope of 1 in 10
- side walls shall be keyed into original ground for a minimum depth of 300mm

(C) ACCESS

- access shall be provided for cleaning by mechanical equipment such as front end loaders, back hoes, and tip trucks. The access shall be a separate all-weather track and ramp designed for a 7

tonne wheel load in a W-7 configuration in accordance with the TRIS 07 – Bridges and Related Structures. Where possible, trucks should be able to drive within close proximity to where the loader is operating

- the access track to the trap shall have a minimum clear width of 3.7 m and a maximum longitudinal grade of 1 in 6
- the access ramp into the sediment trap shall have a minimum clear width of 6.0 m and a maximum longitudinal grade of 1 in 6. The 6.0 m clear width shall extend from the floor of the trap to the end of the side wall returns. Where the length of a trap is less than or equal to 15.0 m, the access ramp shall extend for the entire length of the trap
- an access ramp and apron shall also be provided for the downstream side of the trash rack and shall have a minimum clear width of 4.0 m and a maximum longitudinal grade of 1 in 6
- transitions shall be provided at the crest and toe of the ramps. Adequate space shall also be provided to allow vehicles to manoeuvre on and off the ramps.

(D) PUBLIC SAFETY

Public safety shall be considered and the following minimum safeguards shall be provided;

- hand rails at vertical drops where appropriate
- maximum side slopes adjacent to side walls shall be 1 in 6.

Minor DUS GPT

Minor DUS GPTs shall conform to the general requirements of Standard Drawing ST-0032 and shall incorporate the following specific features;

(A) TRASH RACK

- grill spacing shall be capable of retaining a 375 ml metal drink container
- trash racks shall be sized to operate effectively during flows up to and including the 1 year ARI
- trash racks shall be structurally stable when overtopped by flows up to the total inlet design capacity or when fully blocked
- trash racks shall be able to withstand impact from a piece of debris weighing 250 kg and travelling at 2.0 m/s
- trash racks shall conform to Standard Drawing ST-0034
- the standard panel width shall be 1.9 m.

(B) SEDIMENT TRAP

- the width shall be 2.0 m
- the allowable length shall be in multiples of 2.0 m within the following limits,
  - minimum length: 4.0 m
  - maximum length: 12.0 m
- the maximum depth of the GPT from the top of the concrete surround to the lowest level of the sediment pool base shall be 4.5 m
- pipe entries shall be either parallel or perpendicular to the major axis of the GPT. Angled pipe entries will not be permitted
- for GPTs with a sediment trap volume greater than 5 m^3, a sediment drying area with a minimum area equal to 1.5 m^2 for each cubic metre of trap volume shall be provided. The area shall be

surfaced with 300 mm of compacted gravel
- the width of baseflow discharge over the trash rack weir wall and dowstream apron shall be kept to a minimum, preferably confined within a single trash rack panel
- the top of the structure shall be at least 150 mm above finished surface level to discourage vehicles from being driven onto the structure.

(C) ACCESS
- access shall be provided for cleaning by mechanical equipment such as front end loaders, back hoes, and tip trucks. The access shall be a separate all-weather track designed for a 7 tonne wheel load in a W-7 configuration in accordance with the TRIS 07 – Bridges and related structures.
- access tracks shall have a minimum clear width of 3.7 m and a maximum longitudinal grade of 1 in 6. Adequate space shall also be provided to allow vehicles to manoeuvre in the vicinity of the GPT
- access shall be provided along the full length of at least two sides of the GPT as shown in Figure 4.27
- a clear opening shall be provided for the full length of the trap. Support beams across the top of the trap will not be permitted as they restrict maintenance operations.

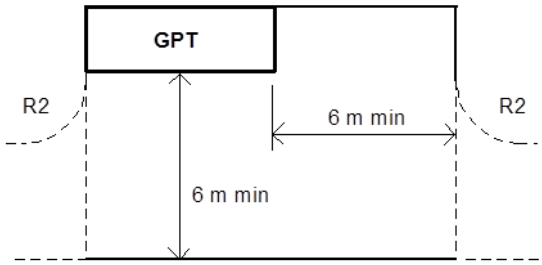


Figure 4.27 Access to GPT

(D) PUBLIC SAFETY

Public safety shall be considered and the following minimum safeguards shall be provided;
- hand rails at vertical drops where appropriate
- maximum channel side slopes immediately downstream of the outlet shall be 1 in 6 unless directed otherwise

(E) COVERS

Minor DUS GPT covers shall be fabricated using galvanised pressed steel mesh or similar. Recessed lifting lugs shall be provided at each corner to enable wire cables and/or hooks to be attached to enable lifting by maintenance equipment.

Covers shall be designed to be free spanning. GPTs shall have a clear unobstructed opening when all covers are removed.

The weight of the covers shall be governed by the following limitations;
- minimum weight shall be 80 kg
- maximum weight shall be 300 kg.

(F) STEP IRONS

Step irons shall be located on the shortest dimension of the GPT in such a manner that will not restrict the movement of a backhoe arm. Refer to Figure 4.28.

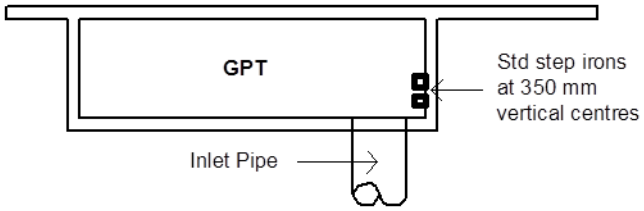


Figure 4.28 Step irons in GPT

DUS GPT DESIGN METHOD

The method for sizing of major and minor DUS GPTs is based on correlations of predicted annual retention of sediment in a GPT and the expected average annual export of coarse sediment from Canberra catchments.

Notation and Definitions

A	Level difference between inlet base of invert and trash rack (m)	L_t	Length of sediment trap (m)
		M_{01}	Annual sediment transportation (tonnes)
A_c	Catchment area (m^2)	N	Number of trash rack panels
A_t	Minimum sediment trap area (m^2)	P_{01}	Retention of grain sizes ≥ 0.01 (%)
A_t^*	Actual sediment trap area (m^2)	P_{04}	Retention of grain sizes ≥ 0.04 (%)
B	Minimum clearance over trash rack (m)	Q_1	1 year ARI flow rate (m^3/s)
D_s	Depth of downstream sill (m)	Q_p	Total inlet pipe capacity (m^3/s)
D_t	Total depth of sediment trap (m)	U	Degree of urbanisation (%)
D_w	Depth of sediment trap pool (m)	V_1	Nominal 1 year ARI flow velocity (m/s)
H_r	Trash rack height (m)	V_t	Volume of sediment trap pool (m)
H_r^*	Adjusted trash rack height (m)	W_t	Width of sediment trap (m)
Il_{in}	Inlet invert level (m)	Y_1	1 year ARI flow depth in inlet pipe or upstream floodway (m)
L_r	Length of trash rack panel (m)		

Surface Area of Sediment Trap

- Determine the catchment area (A_c) served by the GPT and the degree of urbanisation (U) for the ultimate catchment development
- Determine the type of GPT required from Figure 4.29
- Determine the required area ratio At /Ac from Figure 4.30 for P_{04} = 70% and the degree of urbanisation (U)
- Determine the minimum trap area (A_t)
- Determine the trap length and width using,
  - for a Major DUS GPT,
    W_t = integer multiple of 3.0 m or 5.0 m
    L_t = $2W_t$ to $3W_t$
  - for a Minor DUS GPT,
    W_t = 2.0 m
    L_t = integer multiple of 2.0 m
    (minimum 4.0 m, maximum 12.0 m)
- Determine the actual sediment trap area from,
  A_t^* = $L_t W_t$ ($A_t^* \geq A_t$)

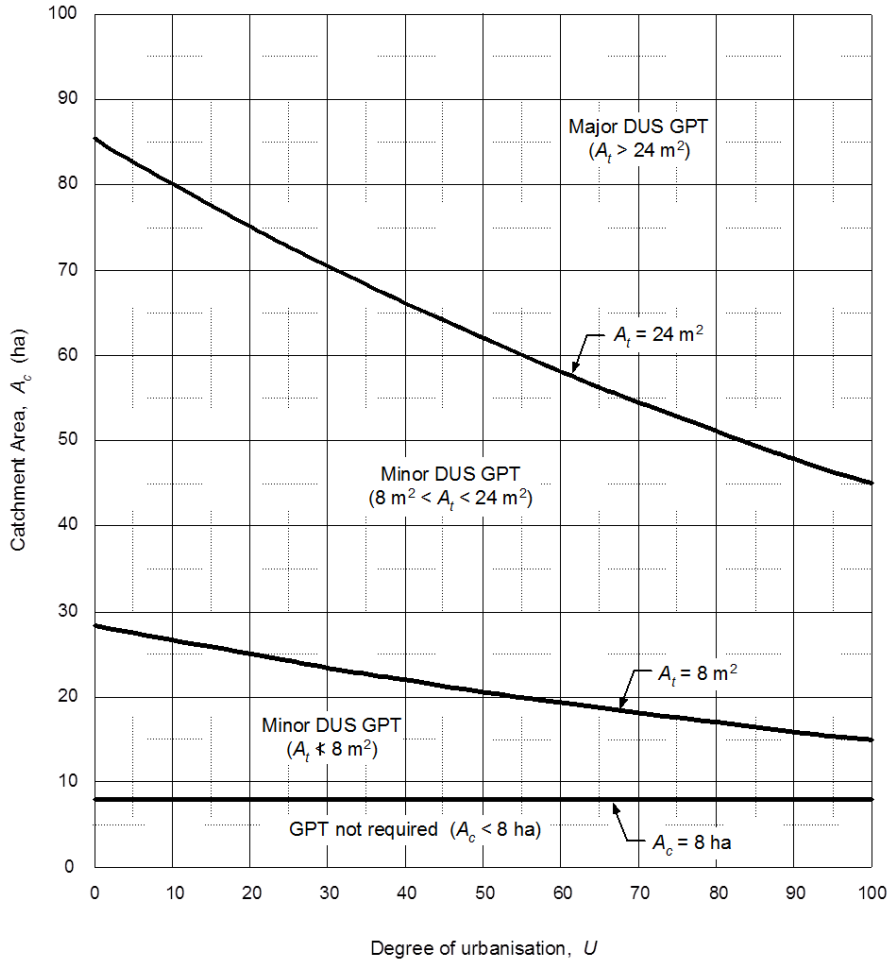


Figure 4.29 Selection of GPT Type Against Catchment Area and Degree of Urbanisation

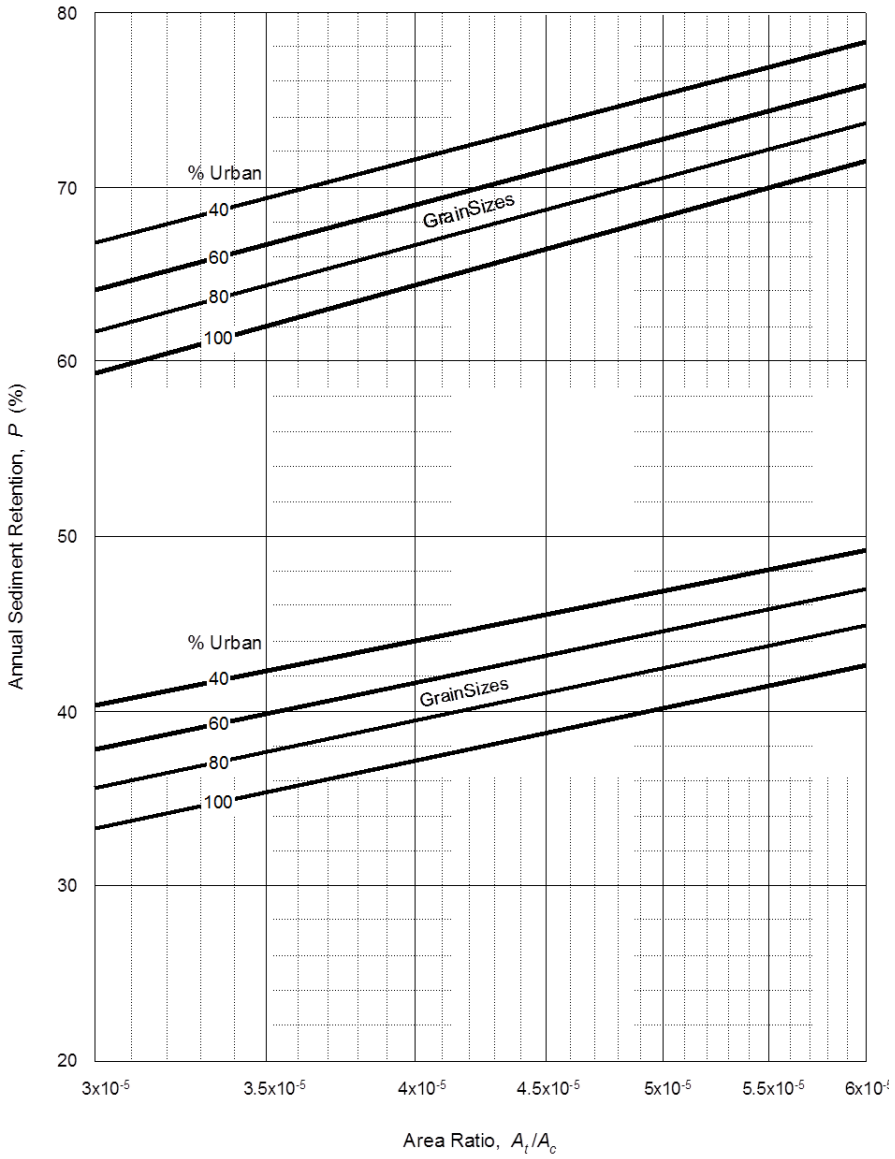


Figure 4.30 Average Annual Sediment Retention Against Area Ratio

Depth of Sediment Trap

- Determine the average annual sediment export of grains ≥ 0.01 (M_{01}) from Figure 4.31
- Determine the average annual percentage retention of sediment ≥ 0.01 mm (P_{01}) from Figure 4.30 for A_t / A_c
- Determine the sediment trap pool volume below the trash racks using:

  $\mathbf{V_t} = \quad 0.0065\ P_{01}\ M_{01}$

  This relationship is based on a sediment density of 2.65 tonnes/m^3 and a sediment porosity of 0.42.

The required sediment trap pool volume is a function of the average required cleaning frequency. The following is based on an adopted average cleaning frequency of 2 times per year.

- Determine the sediment trap pool depth below the trash racks using,

$$D_w = \frac{V_t}{A_t^*}$$

- For a Minor DUS GPT, the total depth of the sediment trap (D_t) shall not exceed 4.5 m.

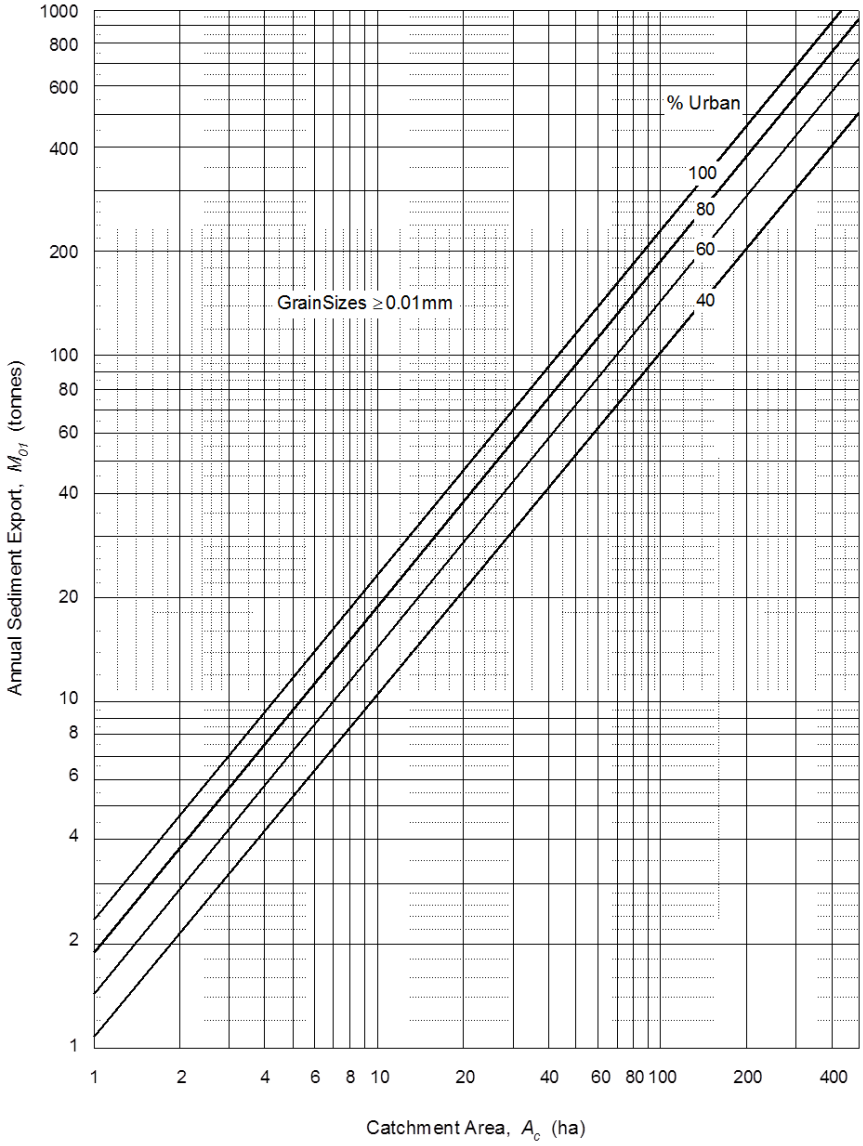


Figure 4.31 Average Annual Export of Sediments ≥ 0.01 mm Against Catchment Area

Trash Rack

(A) NUMBER OF PANELS

Determine the number of trash rack panels (N) required based on the following centre to centre panel dimensions;

- 3.0 m or 5.0 m (Major DUS GPT)
- 2.0 m (Minor DUS GPT)

(B) HEIGHT

Generally, the trash rack height is based on the rack not being overtopped by a 1 year ARI flow when the rack is 50% blocked.

The following is based on a standard trash rack with vertical 10 mm galvanised flat steel bars at 60 mm centres. A coefficient of 0.8 to account for contraction of flow through the trash rack has been assumed.

- Determine the trash rack height using,
  - for a major DUS GPT

$$H_r = 1.22\left(\frac{Q_1}{L_r\, x\, N}\right)^{2/3}$$

  - for a Minor DUS GPT. Refer to Figure 4.32

Hr	**=**	0.3 m	(QI ≤ 0.23 N)
Hr	**=**	0.5 m	(0.23 N ≤ QI ≤ 0.50 N)
Hr	**=**	0.7 m	(QI > 0.50 N)

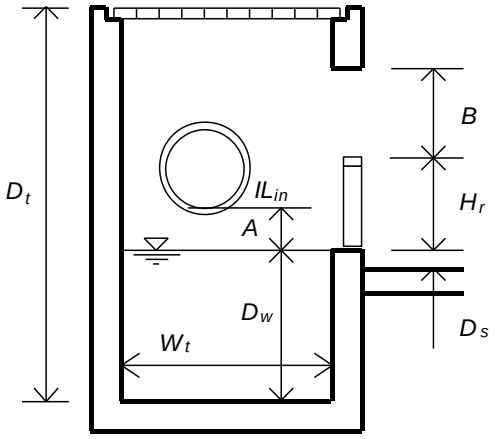


Figure 4.32 Minor DUS GPT Dimensions

Where a trash rack is easily accessible, the height shall be increased for public safety to,

Hr*	**=**	1.2 m

- Determine the maximum trash rack sill level in relation to the 1 year ARI flow depth (Y_1) and the inlet invert level (IL_{in}) using,
  - for a Major DUS GPT,

$$A = H_r + \left(\frac{Q_1}{1.7 W_t}\right)^{2/3} - Y_1$$

  - for a Minor DUS GPT,

$$A = H_r + \left(\frac{Q_1}{3.23 N}\right)^{2/3} - Y_1$$

(C) CLEARANCE ABOVE TRASH RACK

This criterion only applies to a Minor DUS GPT and is based on the unobstructed clearance required to discharge the total inlet pipe capacity.

- Determine the minimum clearance over the trash rack using,

$$B = \left(\frac{Q_p}{3.23 N}\right)^{2/3} \quad (0.350 \text{ m min})$$

(D) SUBMERGENCE EFFECTS

A step shall be incorporated at the trap outlet to reduce possible submergence effects at the trash rack which may in turn create adverse backwater effects in the inlet pipe or upstream waterway.

Ds **=** 0.080 m (minimum)

Flow Velocity

The flow velocity in the GPT should be minimised to inhibit the re-suspension of deposited particles. The nominal velocity for a 1 year ARI flow should be less than or equal to 0.5 m/s. The required pool depth below trash rack level should be checked against this criterion assuming the water level is at the top of the trash rack.

- Determine the nominal flow velocity using,
  - for a Major DUS GPT,

$$V_1 = \frac{Q_1}{(D_w + H_r)W_t} \leq 0.5$$

  - for a Minor DUS GPT,

$$V_1 = \frac{Q_1}{(D_w + H_r)L_t} \leq 0.5$$

- Increase the dimensions of the sediment trap pool or increase the track rack height if the flow velocity is greater than 0.5 m/s.

Reference Section	ACT Practice, Complementary Material, or Departures	Date
6.2	Supplementary requirements **Culverts** Culverts are to be designed to accommodate the design flows for the 100 year ARI storm.	
7	Complementary information **Treating Pollutants** Designers should also refer to ESDD Waterways, Water Sensitive Urban Design General Code for additional information on these treatments.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 6: ROADSIDE DESIGN, SAFETY AND BARRIERS PUBLICATION DATE: 2010		
Introduction to roadside design and guidance on roadside safety and the selection and use of road safety barrier systems. Provides information to understand principles that lead to the design of safe roads, identify hazards, undertake a risk assessment process of roadside hazards, establish the need for treatment of hazards and determine the most appropriate treatment to mitigate hazards. Provides a comprehensive design process, guidance and design considerations for the selection and placement of suitable road safety barrier systems.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 6 of the Guide is adopted for the practice in ACT and is to be read in conjunction with the following attachments to this supplement: Section 6 – Fences, Guardrails and Barriers Attachment A – Street Lighting Attachment B – Pedestrian and Cyclist Facilities	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 6A: PEDESTRIAN AND CYCLIST PATHS PUBLICATION DATE: 2009		
Guide Part 6A: Pedestrian and Cyclist Paths Guidance on the design of paths for safe and efficient walking and cycling. Main focus is the geometric design of paths and related facilities such as intersections between paths, and terminal treatments. Detailed guidance on path location, alignment, width, clearances, crossfall, drainage and sight distance requirements. Should be used with reference to Part 6 and Part 6B.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 6A of the Guide is adopted in principle for the practice in ACT in conjunction with the following attachments to this supplement: Section 6 – Fences, Guardrails and Barriers Attachment A – Street Lighting Attachment B – Pedestrian and Cyclist Facilities	
	Trunk Road Infrastructure Technical Specification – Pedestrian and Cyclist Facilities is to be followed where there is any difference with GRD Part 6A	
	Pedestrian crossings - the warrants for a pedestrian crossing are to be in accordance with: AS 1742.10 : Manual of Uniform Traffic Control Devices – Pedestrian Control and Protection The warrants for Signalised Crossings are contained in Attachment B– Pedestrian and Cyclist Facilities	

Guide Part 6B: Roadside Environment Guidance on types of features and facilities that may need to be accommodated within a roadside, to support the functional requirements of the road, enhance the roadside environment, and minimise environmental impacts. Design objectives, principles and considerations for a diverse range of roadside functions, features and facilities relating to environmental aspects, roadside amenity and roadside infrastructure. Emphasises the need to meet ecologically sustainable development principles in relation to stormwater run-off and fauna management; provides guidelines for fauna crossings and noise control.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	This supplement is to be read in conjunction with the following attachments to this supplement: Section 6 – Fences, Guardrails and Barriers Attachment A – Street Lighting Attachment B – Pedestrian and Cyclist Facilities	
	The requirements for the Main Avenues and Approach Roads as outlined in the Supplement to Part 2 of the Guide are to be in accordance with the requirements of the National Capital Authority (NCA).	

	Roadway lighting - for roads within the jurisdiction of the NCA, the requirements of (the NCA design documents) are to be met. Roads within the jurisdiction of CASA are to meet the requirements of CASA.	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 7: GEOTECHNICAL INVESTIGATION AND DESIGN PUBLICATION DATE: 2008		
A basic appreciation of the importance of geotechnical investigations and how road design outcomes and other design activities are influenced by site conditions, associated ground response, geological hazards and locally available materials. Provides assistance in preparing briefs and purchasing geotechnical services. Basic information on laboratory tests and some commonly used special geotechnical treatments associated with geotechnical design activities.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 7 of the Guide is adopted with no exceptions in principle for the practice in ACT	

SUPPLEMENT TO THE AUSTROADS GUIDE TO ROAD DESIGN PART 8: DESIGN PROCESS AND DOCUMENTATION PUBLICATION DATE: 2009		
Guidance on the application of quality management system standards to road design. Outlines good design tailored to meet the needs of current and future generations through the integration of many factors generally described as including user safety, workplace safety, environmental protection, social advancement and economic prosperity. Brings together all design elements and examines and ensures that interfaces are appropriate.		
Reference Section	**ACT Practice, Complementary Material, or Departures**	**Date**
General	Part 8 of the Guide is adopted in principle for the practice in ACT, with the following note: This part of the Guide provides only general guidance. Specific processes and documentation should be completed on a case by case basis.	

5 ROAD VERGES

This section provides the basis for verge design associated with all new trunk road roadworks in the ACT. It is to act as the technical support for ACT Code for Residential Development (ACTCODE) to provide the more detailed design necessary for the design of verges, particularly in residential developments, in accordance with ACTCODE principles.

This section can also be used for roads outside the scope of ACTCODE such as traffic routes and roads servicing industrial, commercial and other public areas.

Specifications for road verges on local roads can be found in the Development Infrastructure Standards (DIS).

5.1 APPLICATION AND USE

Performance Orientation

It has been traditional for Road and Services Authorities to split up verges into standard alignments for individual services on different classes of road. This practice is not considered to be compatible with the performance approach now being adopted for subdivision design and can lead to verges, which are unnecessarily wide or sometimes too narrow, when non-standard utility installations are required.

The approach specified in this document provides designers and developers with the opportunities to apply innovative, flexible and cost effective solutions to the verge design while ensuring that the verge maintains its functionality.

At an early stage in the design process, there will be a need to demonstrate that all services; plantings and paths can be accommodated within the verge area.

Verge Modules

To assist designers, the service authorities have defined modules for each of their services. The modules specify both width of reservation and the limitations on the location of the module. The attached standard drawings, DS04-1 and DS04-2, and following sections fully describe each of these modules.

The minimum width of verge required for each particular road within a development can be determined by adding up all the modules for services and landscaping elements contained in that road.

5.2 VERGE DESIGN – GENERAL PRINCIPLES

The Verge Function

The verge performs a number of important functions including:

- providing space for the provision of underground and above ground services including plant and equipment, bus stops etc
- providing space for landscaping to improve the appearance of the street environment
- providing a drainage function for overland flows
- providing for the movement of pedestrians and cyclists
- providing adequate sight distances for traffic on the road (including cyclists and pedestrians on a path) to see vehicles pedestrians or cyclists entering the roadway from blocks.
- providing a buffer area for reduction in traffic noise level at dwellings
- providing for level differences between carriageway and blocks
- providing areas for parking off the carriageway if the road pavement is narrow.

The verge should be of sufficient width to allow space for all relevant services, landscaping, indented parking, future carriageway widening, cyclepaths and swale drains.

Co-location of Public Facilities

The co-location of public telephones, post boxes, bus stops and drop-off bays to create activity nodes is encouraged.

Verge Crossfall

Factors requiring consideration in the selection of verge crossfall are:

a. Drainage

- The minimum desirable verge crossfall should be 1 in 100 (1%).
- There should be sufficient rise from the top of the kerb to ensure that the 1 in 100 year stormwater flow does not encroach onto blocks.

The maximum depth of flow shall not exceed the requirements of this Trunk Road Infrastructure Standard, listed in supplement to the Austroads Guide Part 5: Drainage Design.

b. Verge Crossfall

- Changes of grade across the verge should not be so severe that vehicles cannot easily enter block driveways without scraping. In general, because driveways can be located at any location along the verge, the whole verge needs to be designed to suit vehicle access.
- The maximum desirable verge crossfall, commensurate with providing a safe working platform for construction and maintenance operations, and adequate block access is 1 in 6 (17%).
- The maximum mowable slope is 1 in 4. However this is not a suitable crossfall if trenching operations for installation of underground services are necessary.
- Where the verge is free of utilities or other services and there is no requirement for block access, grades steeper than 1 in 4 may be acceptable with appropriate landscape treatment.
- Driveway gradients within blocks should be limited to a maximum of 1 in 5 (20%) as gradients in excess of this can mean that the driveway is dangerous or unusable in wet or frosty conditions.
- For access requirements for commercial vehicles, Designers should refer to AS 2890.2.

c. Crossfall Adjacent to Kerb

An area of approximately 2.5 metres at 2% grade towards the kerb is required adjacent to the kerb for the following reasons:

- to enable driveway access to blocks without vehicles scraping (however, direct access should be limited on trunk roads).
- to provide freeboard for stormwater gutter flows.
- for wheeled bin placement.
- for pedestrian and cycle refuge.

d. Crossfall at paths

Paths should be sloped at 2% in the same direction of the general verge crossfall. Paths sloped adverse to the general verge crossfall act as levies collecting and concentrating stormwater runoff. These concentrated flows can cause considerable nuisance and damage.

A 2% shoulder of minimum width 500mm should be provided to all paths.

5.3 PATHS, LANDSCAPING AND OTHER ABOVE GROUND SERVICES

Paths

The criteria for provision and width of paths in residential areas are detailed in ACTCODE, as well as the DIS. For additional design advice refer to Austroads *Guide to Road Design Part 6A – Pedestrian and Cyclist Paths*.

Clearance from carriageway

Standard drawings DS4-01 to DS4-04 show acceptable minimum distances to provide clearance from:

- kerbside placement of wheeled bins for collections of household garbage and recycling waste
- opening car doors when cars are parked at the kerb
- vehicles parking partially on the verge and partially on the carriageway.

Clearance from property line

Sufficient clearance should be provided between the edge of all paths intended for use by cyclists (1.8 metre and wider) and the property line to ensure a cyclist using the path has a clear sight line of sufficient distance to avoid collision with a vehicle reversing from a driveway. Figure 5.1 indicates criteria to be considered and shows acceptable minimum clearances for paths fronting residential blocks.

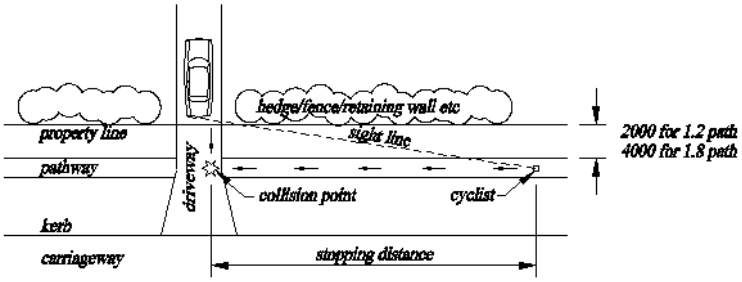


Figure 5.1 Pathway sight distance

Although clean trunk trees are permitted within the sight distance zone, other objects such as substations or low branching trees are not.

For multi-unit developments with off street parking, designers should refer to AS 2890.1.

Location

The following additional factors should be considered when determining the path location:

- locate paths away from underground services, especially deeper trenches in order to avoid path repairs related to trench settlement;
- future service repairs to services under paths;
- avoidance of manholes and sumps to avert potential trip hazards.

Personal Safety and Access

The relationship between landscaping, lighting and other fixtures should be considered to promote both personal and physical safety.

For safety reasons the path should be well lit. Where trees and streetlighting are located on similar alignments, adequate space should be allowed between them to allow for tree canopy development.

Access for people with disabilities should be considered especially in relation to the placement of street signs, parking meters and other objects in commercial or shopping centre verges. For further design advice, Designers should refer to Austroads *Guide to Road Design - Part 6B Roadside Environment*.

Trees

a. General

The most important role of trees is to provide streetscape which is the major element in the design of suburban Canberra and the primary visual role of the verge.

The tree growth characteristics (including the root zone) should be considered in the overall design of the street space and the species should be nominated.

b. Clearance to Paths and Streets

For clearances on traffic routes Designers should refer to Austroads *Guide to Road Design – Part 6 Roadside Design, Safety and Barriers*.

c. Reservation Width and Clearance to Services

Tree root intrusion can be a problem to most underground services. The planting reservation width of 1200mm shown in the tree module includes allowances for separation to other underground services, and for planting/ service alignment error.

The 1200mm reservation width has been determined following extensive consultation with the relevant operating authorities and has been set at the absolute minimum level. It provides sufficient width to allow for the planting of advanced stock.

Service ties are particularly susceptible to tree root intrusion and should be located as far a practical from the root zone. Grouping service ties provides more space for planting and tree development.

d. Sight Lines

Design proposals should ensure that placement of trees will maintain vehicle sightlines in accordance with the Austroads *Guide Road Design Part 3 – Geometric Design*.

e. Root Barriers

Designers should refer to respective specifications for details on root barriers.

The consideration for the installation of root barriers should be dependent on tree species and surrounding assets. Details for this are covered within the DIS.

Above Ground Electrical Plant and Equipment

Designers need to accommodate, within the verge space, the placement of streetlight columns, pad-mount substations and mini-pillars and power poles in overhead power areas.

This should be arranged early in the design process with ActewAGL to allow for the efficient integration of this equipment etc into the verge space.

Streetlight columns should be placed a minimum of 1.7 m from the kerb or 3.0 m for roads without kerb and gutter in accordance with ActewAGL guidelines.

Streetlights, substations and mini-pillars or power poles should be placed clear of future driveways. Restricted vehicular access should be designated at these locations on the Lease and Development Conditions. Substations shall be kept clear of the driveway sight distance envelope.

Driveways

Driveway access should be limited where possible on trunk roads. Access should only be provided with prior approval from relevant authorities, such as ACTPLA and Roads ACT.

The positioning of the driveways to small blocks is dependent upon the final car accommodation location in relation to design and siting requirements and other factors such as building cost.

The Designer should, early in the design process, endeavour to determine in conjunction with the likely car accommodation locations.

Structures that must be located clear of possible driveways include:

- trees

- streetlight poles
- power poles
- drainage sumps
- pad-mount substations
- mini-pillars
- traffic and street signs
- bus stops and shelters
- fire hydrants
- other road furniture

Where possible, manholes, service ties, water meters and junction pits should also be kept clear of driveways.

The location of driveways opposite the terminating road of a T-junction should also be avoided, and the block layout should be planned accordingly.

Block access gradients are discussed in Section **Error! Reference source not found.**, under the heading Verge Crossfall'.

Bus Stops and Shelters

Details on bus stops and shelters can be found in the ACTCODE and DIS.

Traffic Signs

Traffic signs shall be located in accordance with AS 1742.2 and their placement shall take precedence over other verge structures and landscaping.

The shared use of signs and the use of street furniture (eg. light poles) for the placement of signs should be adopted whenever possible.

5.4 TERMINOLOGY

The Austroads *Glossary of Terms* is the source of definitions and meanings for the most commonly used terms in this specification.

5.5 DRAWINGS

- Service Modules Sheet 1 of 2 – DS4 - 01
- Service Modules Sheet 2 of 2 – DS4 - 02
- Verge Gradients and Access requirements – DS4 - 03
- Footpath Modules – DS4 - 04

6 FENCES GUARDRAILS AND BARRIERS

This section covers the requirements for all classes of safety barriers and fences in the public realm except for barriers associated with bridges, which are covered in TRIS 07.

6.1 GENERAL REQUIREMENTS FOR BARRIERS AND FENCES

The decision to install protective barriers at any location should not be taken lightly. In almost every case it is preferable to permanently remove the hazard rather than accept the ongoing costs of a barrier. These ongoing costs must be carefully assessed and included in the financial analysis when making the decision to adopt a "protect against" rather than an "eliminate" solution.

Where barriers are required they shall also be designed to:

- allow rapid maintenance and replacement (e.g. cast in balusters are not acceptable);
- satisfy architectural and aesthetic requirements;
- be consistent with adjacent structures;

- exhibit high resistance to vandalism
- be durable against weathering and deterioration
- have a low whole-of-life cost.

Paint finishes should be selected on the basis of superior resistance to fading, vandal resistance and appropriateness for the surface they are coating. Graffiti coatings should be considered for surfaces likely to be affected by graffiti.

6.2 COMMON PROBLEMS

Hazard removal

Designers should examine carefully the potential for removal of the hazard rather than installing safety barriers. The following treatments have been successfully applied to eliminate the need for barriers on both traffic routes and pedestrian or cycle routes.

- Extend culverts until the end is out of the clear zone. This is usually possible on the downstream side of the road and sometimes possible upstream.
- Convert culvert inlet to plantation sump. This is a possible treatment for those areas where the upstream end of the culvert can't be extended and pipe sizes are not too large.
- Widen the embankment and reduce the slope.
- Remove trees. This is possible even under the protection legislation if the trees are not native species and not classified as significant.
- Convert pole bases to slip bases. An isolated pole with a slip base is usually less of a hazard than the alternative long length of barrier.
- Relocate roadside furniture. Signs, poles transformers etc can often be relocated to positions outside the clear zone without affecting their performance.

Insufficient Length

In many cases, short lengths of barrier have been installed to "protect" an isolated hazard. In most of these cases an analysis of vehicle path will show that, unless the vehicle turns sharply and approaches the hazard at right angles to its normal direction of travel, the barrier will not prevent the vehicle from striking the obstruction.

If the barrier is a flexible type such as the common W beam, it needs to be a minimum of 20 metres long to dissipate the energy of the collision through deflection of the rail. Shorter lengths are likely to be displaced from the ground and add to the severity of the accident.

Deflection

Steel beam and wire rope safety barriers are designed to absorb the energy of a crash by deflecting. Vehicles may still impact obstacles that are very close to the back of the rails. Even if the vehicle does not contact the obstacle, the obstacle may interfere with the normal functioning of the rail by limiting the deflection.

Access gaps

Areas where vehicles or pedestrians need to pass through the barriers need careful treatment. They will usually require the standard end treatment on both sides of the gap. There are some very poor examples of this where the smooth face of the barrier abruptly disappears and presents the vehicle with an untreated end.

Foundations

Performance problems can arise when the foundation conditions do not comply with the standard specified for a particular type of barrier. Examples include concrete paving around the bases of posts on W beam rails which prevents the designed deflection on impact or posts which are too close to the embankment to provide sufficient soil pressure to limit movement to design values.

6.3 VEHICLE BARRIERS

General

Selection of sites for the installation of vehicle safety barriers is to be based on the document *Considerations for the provision of safety barriers on rural roads*. Due consideration should be given to clause 3.4.1 of this document which states that that barriers should only be installed when the consequences of impact with the unshielded hazard are greater than the consequences of impact with the barrier. In making this assessment, designers should bear in mind also the probability of impact with a fairly compact hazard compared with the probability of impact with the much longer length of barrier that may be needed to shield the hazard.

Selection of type of barrier and structural design of barriers should be based on *AS/NZS 3845:1999* and the Austroads *Guide to Road Safety Part 9: Roadside Hazard Management, Section 3.3: Safety Barriers*. Installation drawings for barriers and transitions between different types of barrier should also be based on this standard.

Traffic barrier types should be chosen taking into account the following:

- the level of risk that the barrier itself presents as a hazard;
- level of risk involved in the event of vehicles leaving the carriageway;
- containment of vehicles within the structure or roadway;
- minimising accelerations and smoothly re-directing errant vehicles;
- protection of adjacent land users.
- protection of other users (e.g. cyclists, pedestrians, equestrians etc.);
- maintaining sight lines (by widening or modifying alignments as appropriate).

Rigid barriers other than concrete barriers

Although *AS/NZS 3845:1999* refers to barriers comprised of rails on posts in the section on rigid barriers, it does not contain any illustrations of this type of barrier when illustrating the use of rigid barriers. This has led to some confusion as to the applicability of clause 3.9 when the rigid barrier system is post and rail as opposed to continuous concrete. All the illustrated rigid concrete barriers have some form "kerb" within their shape.

Research by the RTA has indicated that barriers should only be aligned with the face of kerb in speed zones of 70 kph and lower. It is desirable to place the barrier 200mm behind the kerb to allow for the overhang of the body beyond the wheels as depicted in Figure 0-1.

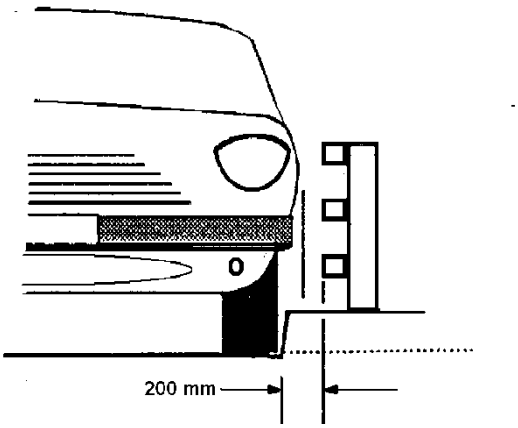


Figure 0-1: Positioning of barriers

Terminals

Terminals shall comply with the evaluation criteria of NCHRP Report 350, Test Level 3, or be listed by the Federal Highway Administration (FHWA) of the US Department of Transport, for use on the National Highway System (NHS) at Test Level 3 or higher.

a. Flexible rails

Note that the Breakaway Cable Terminals as depicted on the old Standard Drawings GW/SD/DC/07 and GW/SD/DC/08 do not comply with the requirements of *AS/NZS 3845:1999* and must not be used.

The Modified Eccentric Loader Terminal (MELT) or Slotted Breakaway Cable Terminal as described in *AS/NZS 3845:1999* may be used in locations which meet the minimum installation and site requirements of Table B3. Alternatively proprietary terminals may be used in accordance with the requirements of their NCHRP 350 test certificates.

b. Non-Gating Terminals

Non gating terminals are those which do not allow penetration or pocketing during impacts near the nose. They will generally be used at the ends of rigid barriers or other rigid obstructions such as bridge piers or parapets.

Designers should bear in mind when specifying non-gating terminals that they are available in various degrees of reusability with large differences in the number of components that need to be replaced following an impact. In general, the terminals having a larger proportion of sacrificial components will have a lower installation cost but a higher maintenance cost and a higher restoration cost after impact. There are systems available which will fully recover without replacement of any components but these are generally more expensive to install.

Designers must carefully specify the chosen type of terminal to ensure that systems having higher whole of life costs are not substituted during the construction phase.

Interfaces between different classes of barrier

See Clause 2.3.12 of *AS/NZS 3845:1999* for a discussion of this issue.

Where two different road safety barrier systems are combined together, a transition zone, which facilitates a merge between the systems in a manner which avoids pocketing and snagging during a collision, shall be provided.

Note that the flexible to rigid transitions depicted on the old NCDC standard drawings 1026/88 and 1027/88 must not be used.

Vehicle – Vehicle Separation

Barriers used for separating opposing streams of traffic must be selected bearing in mind the likely deflection of the barrier system during an accident. Where medians are very narrow, rigid concrete barriers with appropriate end treatments are preferred. On wider medians that still require barriers, wire rope type barriers are preferred over back to back flexbeam.

Vehicle – Pedestrian / Cyclist Separation

Under no circumstances should any form of flexible barrier be used to separate vehicles from pedestrians or cyclists. Flexible barriers dissipate the excess energy from an errant vehicle through deformation that can be quite considerable. The presence of a barrier can give pedestrians a false sense of security when the behaviour of the barrier actually means that they are less safe than if the barrier did not exist. (In effect the barrier can act as a very wide bumper bar).

Transit SA has developed guidelines covering the use of specially designed bollards to provide protection of roadside dining areas from impact by errant vehicles (see Clause 2.3 Further Reading). At least three companies can supply bollards that comply with these guidelines. Although there is currently no legislative requirement in the ACT to use such devices, it may be advisable to consider these in circumstances where high volumes of traffic are in close proximity to densely used pedestrian areas.

Exclusion of Vehicles from Public Areas

a. Use of 225 mm kerbs as vehicle barriers

In situations where long lengths of vehicle barriers will be required for playing fields and open space, the use of high kerbs (225 mm) as vehicle barriers rather than the more expensive alternative of standard kerbing with continuous log barriers is preferred. The economic advantages are clear and, in most situations, aesthetic and maintenance advantages will also be gained.

Margins of playing fields abutting roads and car parks are examples of such areas. Other areas of open space offering potential for short-cutting the road system, or gaining access to residential blocks need careful assessment to enable a decision on the use of high kerbs.

Care should be taken in the use of high kerbs that hazards are not created. The use of non-standard kerbs could, in some locations, constitute a hazard where members of the public normally expect to find standard

kerbs. Simple examples are where elderly people or children step off a kerb and are thrown off balance onto the roadway, or where the occupants of vehicles open car doors onto an unexpectedly high kerb.

Particular attention will be required to ensure occupants who do not anticipate non-standard kerbs do not inadvertently damage cars when using car parks around playing fields and open space. Nose-in parking is preferable to parallel parking as a means of reducing the likelihood of this type of accident.

Pram crossings and maintenance access driveways across high kerbs constitute a potential illegal vehicular entry point. Dense landscape planting around such points may effectively block vehicle access. Sturdy staking preferably with steel pickets will be necessary until the trees reach a size when they create a solid barrier. A lockable chain or similar device will allow tractor entry for maintenance.

Standard kerb crossings cannot be used on high kerbs. Crossings whether for vehicles or pedestrians (including people with disabilities) will need to be properly designed to ensure that they comply with appropriate the standards.

b. Bollards

Bollards may be used to control or prevent vehicle access to public places or to provide visual enhancement to a space and their style should be compatible with other street furniture in the area.

Bollards that form the sole means of preventing vehicular access should be spaced at 1.6 metre centres. This should prevent most cars sold in Australia from driving between them.

They should be approximately 1 metre in height and include a reflective panel if sited in a vehicle domain such as a car park. The space between a bollard and a gutter or kerb should allow for pedestrian movement (including people with disabilities) and for vehicle overhangs and door openings.

Bollards must be visible to motorists, cyclists and pedestrians. Bollards should not be a hazard to people with disabilities. They should not be located in the natural desired pedestrian path.

Bollards are prone to vandalism and to unauthorised removal particularly if there is a strong desire for vehicle access to a location. They should have sufficient foundation strength to resist being pushed by a large 4*4 vehicle.

c. Log Barriers

Although log barriers have been extensively used in many areas of the ACT, their use is no longer favoured. They tend to be prone to vandalism and deliberate damage by vehicles and have high maintenance costs as a result. In addition they are a safety hazard to pedestrians because their low height makes them difficult to see particularly at night.

They present a spearing hazard to vehicles when subject to impact end on which means that they should not be used adjacent to roads. Log barriers also present a major obstruction to mowing operations.

Designers who wish to use log barriers on a project should ensure that their designs address these issues when seeking permission for use. Requirements for pedestrian and cycle barriers can be found in the Austroads *Guide to Road Design Part 6A: Pedestrian and Cyclist Paths*.

6.4 CYCLE AND PEDESTRIAN BARRIERS

Barriers adjacent to cycle paths

The need for barriers and the design of barriers adjacent to cyclepaths should be assessed using the provisions in Austroads Report AP-G88-11 *Cycling Aspects of Austroads Guides*. Particular attention must be paid to ensuring adequate clearance from the barrier to the path.

Removal of the hazard should be investigated and the decision to install barriers should consider the whole of life costs of both the barrier and the removal of the hazard.

Barriers in public areas used by pedestrians

In paved areas or areas within 5 metres of a pedestrian path, continuous protective balustrade shall be provided at changes in level greater than 1metre (or 5 risers in the case of a stairway) unless the level difference is via an embankment of slope less than 1 vertical to 2 horizontal.

In areas likely to be used by large numbers of children and where the lower level has a hard surface such as concrete or gravel, barriers must be fitted with protective infils designed to prevent children from being able to climb over, squeezing through or from getting their heads stuck. The minimum acceptable level of protection uses vertical bars with maximum clear spacing of 110mm. Such bars shall be designed to a standard substantial enough to prevent damage by vandals. The use of horizontal members alone shall not be permitted.

In areas of public open space more than 5 metres from a pedestrian path but which meet the other criteria above for needing a barrier, designers should assess the most appropriate form of protection. Possible measures include simple one or two rail fences, bollards, landscape planting (incorporating temporary fencing until landscape is established, increased wall height or combinations of these. It is important that whatever measure is adopted helps delineate the hazard to users of the area and does not introduce an additional hazard (for example low walls or kerbs hidden in long grass could be a trip hazard particularly in low light conditions).

6.5 FENCES AND GATES

Fences

In areas where a fence is the most appropriate way of restricting access for management purposes, a standard stock proof fence is preferred. Brush fencing or other highly flammable fences must not be used.

The standard stock proof fence is comprised of 5 wires (2barbed, 3 Plain) combined with suitable mesh supported on intermediate posts at 40 metres maximum spacing with star picket droppers at 4 metre spacing. Corner posts and gateposts should be equivalent to 250-mm timber.

Gates

In locations where access is required for maintenance vehicles, the preferred gate is the Ranger style as illustrated in Standard drawings DS11-01 and DS11-02. The gate as shown in DS11-2 is a heavy duty style designed to resist deliberate impact by drivers of larger four wheel drive vehicles seeking access to off road areas. It should generally only be necessary in more isolated areas or in areas where there is a history of damage to the standard gates.

Other styles of gate may be permissible provided they are compatible with the surrounding landscape, constructed of durable materials, are lockable and are vandal resistant to a high degree.

6.6 DRAWINGS

Title	Drawing Number
Standard Ranger Gate	DS11-01
Vehicle Access Gate (Heavy Duty)	DS11-02

7 STREET LIGHTING

Standards for the design of street lighting are set out in **Attachment A**. Detailed requirements for street lighting installations are specified in Trunk Road Infrastructure Technical Specification RITS 12.

8 PEDESTRIAN AND CYCLIST FACILITIES

Standards for the design and management of pedestrian and cyclist facilities are set out in **Attachment B**.

9 REFERENCE LIST

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10 STANDARD DRAWINGS

NUMBER	TITLE	REV	DATE
	DRAINAGE DESIGN		
ST-0001	Pipe Junctions	02	March 1998
ST-0002	Pipe Details	02	March 1998
ST-0011	Sump Inlets on Kerbs and Gutters	04	March 1998
ST-0012	Type R and QS Sumps	02	March 1998
ST-0013	Plantation and Grated Sumps	02	March 1998
ST-0014	1050 ND Manholes	02	March 1998
ST-0015	Special Chambered Manholes	02	March 1998

ST-0016	Surcharge Structures	02	March 1998
ST-0017	Structures - Miscellaneous Details	02	March 1998
ST-0018	Pipe Connections to Structures	02	March 1998
ST-0019	Multiple Type R Sumps	01	March 2002
ST-0021	Pipe Culverts 300 - 675 Dia - Endwalls	02	March 1998
ST-0022	Pipe Culverts 750 - 1200 Dia - Headwalls	02	March 1998
ST-0023	Precast Box Culverts - Endwalls	02	March 1998
ST-0024	Precast Box Culverts - Headwalls	02	March 1998
ST-0025	Floodway Low Flow Provisions	02	March 1998
ST-0026	At-Grade Floodway Crossings	02	March 1998
ST-0031	Minor GPT Layout - Parallel to Floodway	02	March 1998
ST-0032	Minor GPT Layout - Perpendicular to Floodway	02	March 1998
ST-0033	Major GPT Layout	02	March 1998
ST-0034	GPT Trash Racks	02	March 1998
ST-0041	Floodway Advisory Sign	02	March 1998

Trunk Road Infrastructure Standard No. 02

ROAD DESIGN

Supplement to Austroads Guide: Road Design

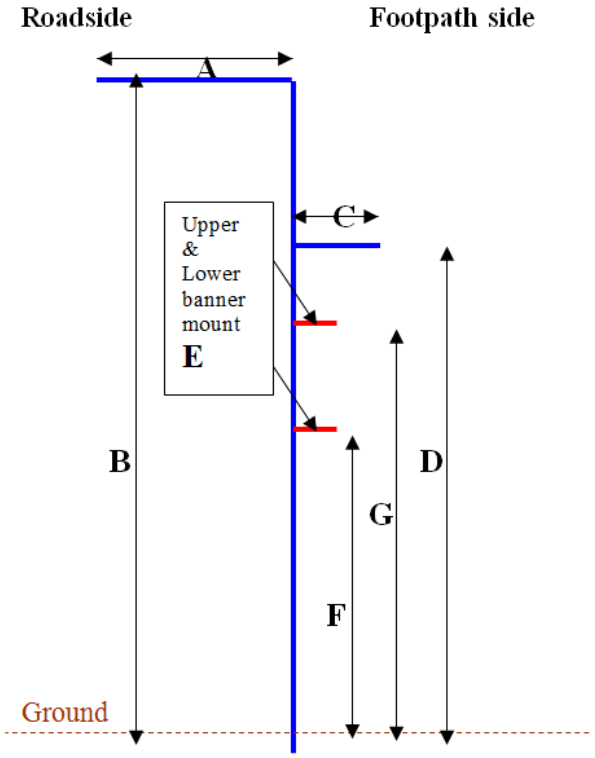
Attachment A

STREET LIGHTING

CONTENTS

1 STREET LIGHTING DESIGN

1.1 STREETLIGHT POLE – DIMENSION LIMITS



Description	Dimension	Outreach Arm	Height	Condition	Clause reference
Roadside column	**A**	1.5, 3, 4.5			1.3
"	**B**		4, 6.5, 9, 10.5, 12, 15		1.2
Pedestrian side column	**C**	0.5, 1.5			1.3
"	**D**		4, 6.5, 9, 10.5, 12, 15		1.2
Banner	**E**	0.5, 1.5		Only on poles > 9 metres in height & designed to withstand wind loadings	1.2, 1.4
"	**F**		2.4 minimum	"	1.2
"	**G**		6.0 maximum	"	1.2

Note Column Heights in Parks, Cycleways, Walkways, Adjacent Underpasses & Adjacent Shopping Centres shall be a minimum of 6.5 metres (see Section 1.2).

1.2 COLUMNS

Lighting columns shall be of the types, heights and outreaches as shown on the Standard Drawings, and shall be of the make and type as described in Section 10, and shall conform with the requirements of the relevant Australian Standard(s). The height of the columns shall be such as to give vertical heights from ground level to the centre of the luminaire spigot of 4.0, 6.5, 9, 10.5, 12, and 15m.

Lighting columns of 9m height or greater shall be of the frangible type, either slip base or impact absorbing. Where high-speed impact absorbing lighting columns are used a service pit as per standard drawing DS12-01 shall be incorporated adjacent to the column so as to provide capacity for cable disconnection if an accident damages the column. Slip base columns shall only be used where there are no designated paths or cycleways within 5 metres of the installed column. Material shall be galvanized light gauge sheet steel or aluminium.

Allowance shall be made for use with luminaires of approximately 12kg weight with a projected windage area of 0.2 square metres. Category V columns shall be designed to permit banner installation between 2.4m and 6m maximum to a serviceability limit state loading of 1kN. No permanent deformation or excessive vibration should occur under Wind Loading of up to 160km/hr for repeated gusts of up to 10 minutes duration, generally as described in AS 1170.2: Minimum design loads on structures. Part 2: Wind Loads.

Should a designer propose to use an 'equivalent' manufacturer from those listed in Section 10, that proposal requires a specific approval request by the designer to TAMS at design stage. Note Proposals for 'equivalents' at construction stage will not be entertained.

1.2.1 COLUMN HEIGHTS IN PARKS, CYCLEWAYS, WALKWAYS, ADJACENT UNDERPASSES & ADJACENT SHOPPING CENTRES

Vandalism Statistics have shown that low poles at locations of parks, cycleways, walkways, adjacent to underpasses & adjacent to shopping centres are far more susceptible to vandalism damage than higher poles. Pole heights in these locations shall be at least 6.5 metres unless the designer can establish to the satisfaction of TAMS Asset Acceptance, that vandalism will not be a problem.

1.2.2 COLUMNS / LUMINAIRES IN PROXIMITY OF TREES

In areas where trees are planted or are to be planted, the lighting design shall take into account the reduction of light levels that may be caused by trees.

Streetlights shall be placed so that the luminaires are below the mature tree canopy or are at least 2 metres clear of the mature tree canopy. Documentation shall be provided with the streetlight design to show the likely mature tree canopy footprint and lower level of canopy.

This will necessitate liaison between the landscape designer and streetlight designer to establish optimum spacing of trees and streetlights.

1.3 LUMINAIRE OUTREACH ARMS

Luminaire outreach arms shall be curved or straight, and on roadside of 1.5, 3.0, and 4.5m in length, and on pedestrian side of 0.5 and 1.5m in length, and set at an installed angle horizontal to the pavement with a final uplift of not greater than 5°. The length of the outreach is the horizontal distance from the vertical centre line of the column to the tip of the outreach, excluding the lamp mounting spigot. All outreach arms shall be secured to the column so that the outreach arm cannot be displaced from its intended position under wind loading of up to 160km/hr for repeated gusts of up to 10 minutes duration, *generally as described in* AS 1170.2: Minimum design loads on structures. Part 2: Wind Loads. Roundabout luminaires shall be mounted on either 3 way or four way outreach arms with 0.5m extensions. In plan the orientation of the outreach arm shall be at right angles to the traffic lane, or 90° to the tangent point of the curve.

1.4 BANNER MOUNTING

Banner installation is to be catered for on columns above 9m only. Banner serviceability loading is to be calculated using AS/NZS 4676 Appendix G using the following regional parameters

p_d	**Design horizontal wind pressure**	**1.0kPa**
p_b	**Regional wind pressure**	**0.9kPa**
K_z	**Terrain category, height factor**	**0.8**
K_t	**Topographical factor**	**1.0**
C_D	**Drag factor**	**1.3**

Each banner shall be attached top and bottom to prevent entanglement with the column, lighting luminaire, regulatory signs, guide signs etc. The total force of each banner will be calculated in accordance with AS/NZS 4676 Appendix G3.2.3 and in all cases shall not exceed 0.5kN per banner and be restricted to a maximum of two banners per column. Banners shall be mounted at a minimum height of 2.4m and at a maximum height of no greater than 6m. Banners shall have a quick release mechanism on the lower mounting that will 'break away' should the wind load exceed the design parameters.

1.5 INSTALLATION OF LIGHTING COLUMNS WITHIN THE VICINITY OF OVERHEAD POWERLINES OR CHAMBER TYPE SUBSTATIONS

In the absence of any conflicting requirements of ActewAGL, the following minimum clearances between overhead powerlines and lighting columns shall be met for slip base and impact absorbing columns:

1.5.1 SLIP BASE COLUMNS

When the conductors of overhead powerlines are parallel to the direction of travel of all vehicles along the road,

a) the distance between the column and the closest overhead electricity conductor shall exceed 0.6 times the height of the highest point on the lighting column.
b) When the conductors of overhead lines are not parallel to the direction of travel of all vehicles along the road the distance between the column and the closest overhead electricity conductor shall exceed 1.2 times the height of the highest point on the lighting column.

Note that at a roadway intersection, some traffic will be travelling normal to powerlines when the powerlines run parallel to one road or the other.

1.5.2 IMPACT ABSORBING COLUMNS

The distance between the column and the closest overhead electricity conductor shall exceed 0.6 times the height of the highest point on the lighting column.

1.5.3 CHAMBER TYPE SUBSTATIONS

An earthing ring is installed round chamber type substations. Any streetlight columns must be clear of the earthing ring, which is at a distance dependent upon the ground resistivity. A streetlight column clearance of 4.75 metres from the outer perimeter of the Chamber Type Substation shall be maintained unless prior written approval is obtained from the Electricity Utility. (ActewAGL).

1.6 INSTALLATION OF LIGHTING COLUMNS SET BACK FROM KERB

1.6.1 CAT P MINOR COLLECTOR, LOCAL ROAD, CUL-DE-SACS ETC

The setback distance shall be 1.7m from the back of kerb, and a minimum 1.5m clearance from vegetation, driveways, footpaths and all other structures, etc. Columns shall be located halfway between individual proposed or existing tree canopies. For maintenance personnel safety, column access hatches shall be placed either facing away from the road or to the side facing away from the oncoming traffic. Place columns on the line of boundaries between blocks. Seek Territory and Municipal Services approval of all other locations before design acceptance.

1.6.2 REAR ENTRANCE ALLEYWAYS

Columns placed in these locations may be situated 1metre from the back of kerb providing the column is adequately protected from damage by vehicles e.g. bollards of sufficient strength to prevent vehicular impact. Without exception a 1 metre clearance must be maintained within the road reserve, around the column, at all times, to permit maintenance and replacement as required. Column access hatches shall be placed either facing away from the roadway or away from the oncoming traffic. Where a column is within 1 meter of a property boundary the column access hatch shall be placed away from the oncoming traffic.

1.6.3 MAJOR COLLECTOR, ARTERIAL ROADS CAT V AND CAT P

Where vehicle speeds exceed 50kmh, setback columns 3m from the back of kerb or the edge of the pavement (outside the impact zone AS/NZS 1158.1.3). All columns shall be frangible in accordance with AS/NZS 1158.1.3 as amended. Columns used adjacent to foot or cycle paths or where residential blocks abut the roadway shall be of the frangible impact absorbing type. Frangible slip base columns shall not be used in situations that pose significant risk to pedestrians. (See 12.4.2 Prescriptive Criteria).

1.7 INSTALLATION OF DECORATIVE STRINGS AND FIBRE OPTIC LIGHTING

Overhead catenary and tree branch (bud lighting) shall use lighting columns designed to accept the catenary loadings or alternatively free standing columns with a minimum catenary mounting height of 4.5m in pedestrian areas and 7m over roadways. Freestanding columns shall be rag bolt mounted with hold down bolts stopping below the finished level. All overhead decorative lighting shall be 24-volt extra- low voltage design. Decorative lighting in public places shall have a minimum clearance of 3m from the finished level or any climbable object in non-trafficable areas. In trafficable areas or over roadways clearances shall be in accordance with the Utilities Act requirements. Optical fibre installations shall utilise standard HID metal halide lamps and shall be installed without colour wheels and motor drives. Optical driver units shall be installed in an environment where lamp heat is dissipated effectively and moisture ingress into the lamp chamber is avoided.

1.8 RELOCATION OR REMOVAL OF EXISTING COLUMNS

A design review of the lighting installation may be required if the relocation of an existing column/s is of a significant nature (greater than 5m). All major roadway lighting columns above 8m in height will require redesign before relocation is permitted. Relocation of columns to an adjacent block will require written approval from the affected lessee. Standard distances shall be maintained from vegetation, roadways and driveways. Columns cannot be removed without written authorisation from Territory and Municipal Services. Where the removal is temporary suitable alternative lighting shall be installed to compensate. All relocation or removed columns shall be recorded on Work as Executed, (WAE) drawing and submitted to the ACT Government to enable the spatial mapping to be updated and the energy billing to be adjusted where necessary. In all cases any column relocated any distance must comply with all electrical standards applicable at the time.

1.9 PERFORMANCE CRITERIA

The streetlighting performance shall be achieved to the recommendations of the Australian Standards using the methods described in the Standards. The design however shall also comply with the additional prescriptive and performance guidelines set out herein. These added requirements are to ensure that the design is:

- Consistent with policy objectives of the ACT Government.
- Compatible with existing infrastructure and can be maintained economically.
- Meets the requirements of the local electricity utility.
- Carried out in consultation with other relevant authorities where applicable.

1.10 PRESCRIPTIVE REQUIREMENTS

The following is a list of prescriptive requirements that apply to streetlighting generally. Additional specific prescriptive requirements may be found in each lighting category type.

1.10.1 COMPLEMENTING TRAFFIC CONTROL DEVICE DESIGN

One aim of the ACT Government is to minimise streetscape clutter. During the streetlight design process the streetlight designer shall negotiate with the Traffic Control Device (TCD) designer to establish common placement of TCD and guide signage onto streetlight columns where ever practicable.

1.10.2 POWER SUPPLY

The designer shall make arrangements with the electrical utility (where the existing street light network is incapable of supplying the proposed streetlighting scheme) to provide a point of supply for the streetlighting sub-mains. This will be undertaken at the preliminary design stage. Generally the power supply will be unmetered. The electricity utility will need to be advised with (as a minimum) the following preliminary design information:

- Number of lights per sub-main
- Wattage of each light
- Voltage drop to last light
- Proposed point of supply
- Proposed lighting layout

The designer shall obtain from the electricity utility details of the adjacent lights as needed for the design process.

Once a preliminary design has been completed it is to be presented to the electricity utility for connection assessment. All costs associated with the establishment of preliminary design information and approval will be at the expense of the designer.

Evidence of electricity utility supply approval (Request For Service form [RFS]) shall be presented with the completed design to Territory and Municipal Services Asset Acceptance for final design acceptance. This shall occur prior to any onsite streetlighting works commencing.

1.10.3 CATEGORY V (ARTERIAL & MAJOR ROADS) AND AREA LIGHTING

Connection of new streetlighting at the point of supply shall be via sub-main protection. Supply of the initial service protection device (service fuses) and final connection to the distribution network shall be the responsibility of the electricity utility.

1.10.4 CATEGORY P (MINOR COLLECTOR & LOCAL ROADS) AND OTHER STREETLIGHTING TYPES

Columns in new underground electricity serviced subdivisions are to be supplied from the closest electricity utility minipillar. Supply of the initial service protection device (service fuse) and final connection to the distribution network shall be the responsibility of the electricity.

Where this type of connection is to occur in an established area, the electricity utility will determine the type of connection. Where a minipillar or utility supply is distant the point of supply must be agreed with the electricity utility prior to design work being finalised.

Where proposed category P streetlighting is to be installed in existing overhead supply areas the streetlights shall be connected directly to the distribution network utilising PE cells for individual luminaire control. Final connection to the electricity utility distribution network shall be the responsibility of the electricity utility**.**

1.10.5 CIRCUIT PROTECTION

This will be completed in accordance with the requirements of AS/NZS 3000 Electrical Installation (Wiring Rules) and Electrical Note 2.

1.10.6 CABLE TYPES

For new installations three phase sub-mains shall be used for streetlighting, except that single phase sub mains may be used for local road and area lighting when electricity utility mini pillars are present. Each lighting column shall have individual automatic circuit breaker protection fitted inside the column. A maximum of three sets of terminations shall be made at any column.

Subject to compliance with AS/NZS 3008, cable sizes and types shall be in accordance with *TAMS Standard Specification for Urban Infrastructure Works Street Lighting Section 14 clause 14.5 Materials* . A minimum of a 4 core 16mm^2 multi strand copper cable shall be used for Cat V lighting sub-mains supplied from a control point. A minimum of 16mm^2 multi strand copper cable shall be used for area lighting sub-mains supplied from a control point. A minimum of a single core 6mm^2 multi strand copper cable may be used from the electricity utility mini pillars to an individual street light. Earthing arrangements shall comply with Electrical Note 2. Ensure that the same neutral source is used for the entire sub-main length. Cabling shall be XLPE insulated/PVC sheathed or equivalent installed in heavy duty Category A rigid PVC conduit. When slip base columns are used provision shall be made for disconnect plugs and flex assemblies in the base of each column in accordance with Drawing DS12 Category 01.

Connections made in cable pits shall be designed for full submersion. All connectors used for aluminium cable shall be the fully sealed insulation piercing connector (IPC) type. Where insulated cables terminate in an outdoor open air environment (e.g. pole top) weather loops shall be adopted to prevent water ingress.

1.10.7 CABLE ROUTE

Cable route shall be in accordance with *Design Standard 4 Road Verges*. The designer shall contact Dial Before you Dig on 1100 and request all existing utility asset information to determine their effects on the proposed design.

Should the need arise to utilise the utility shared trench system; authorisation shall be sought by the designer from the ACT utilities shared trench committee prior to design acceptance. In all cases install cabling in Cat A conduit. In the case of a shared trench arrangement provide a separate layer in the shared trench to maintain working and maintenance clearances from all other utility assets.

For cabling that emanates from a control point such as Category V and non-residential Category P design sub-main conductors shall loop in and out of large (suitable for 4 core 16mm^2 conductors minimum) terminal links provided in the base of columns. When slip base columns are used provision shall be made for disconnect plugs and flex assemblies in the base of each column in accordance with Drawing DS12-Category 01.

The preferred method of control in residential areas is by individual photo-electric cell control integral with each luminaire. A control point cubicle shall supply category V and Category P open area lighting. It may be necessary in other situations where distribution supply is remote to establish a control cubicle for multiple luminaire control. Where this method is proposed, approval shall be sought from the electricity utility. Streetlight main switchboards (control cubicles) shall be free standing and shall **not** be located within electricity utility substations (indoor or pad mounted) or buildings but shall be located in a publicly accessible position suitable for 24hr maintenance access. Control cubicle design shall be in accordance with Drawing DS12 Category 01 and 02. Unless specific written permission is granted by the electricity utility & the Department of Territory and Municipal Services, only electrical supply for streetlighting may be taken from the street light side of the cubicle.

1.10.8 LEASED LAND

Where overhead or underground streetlighting cables are proposed on or over leased land an easement shall be established. Easement width for overhead cabling shall extend 1.5m either side of each of the outermost conductors. Underground easements shall be a minimum easement width of 2m with the proposed conduit and cabling established along the centre line of such an easement.

Whenever currently unleased land is to be gazetted as leased land by the ACT government, existing streetlight assets within the new lease that are required to be retained in order to maintain streetlighting on adjacent unleased land shall be relocated outside the lease or have an easement placed over them. The cost of the relocation or easement shall be borne by the lessee.

1.10.9 STREETLIGHTING FIXED TO BUIDLINGS

Where streetlighting is proposed to be fixed to buildings that will become the assets of the Territory (Power and Maintenance at the cost of the Territory) an appropriate deed shall be prepared and approved by the Government Solicitor and registered on the Territory Lease. The design shall provide external access to luminaries, cabling and control isolation for the Streetlight Maintenance Contractor 24 hours/day 7 days /week. The cost of the deed shall be borne by the lessee.

1.10.10 ENVIRONMENTAL DESIGN REQUIREMENTS

Consideration shall be given to the provision of the most energy efficient design. The use of metal halide or high pressure sodium lamps is preferred to provide minimum illumination levels consistent with the requirements of AS/NZS1158. *(See also Clause 12.3.10.12.)*

1.10.11 OTHER DESIGN REQUIREMENTS

Designs within the city centre precinct shall be in accordance with the city centre design palette and lighting master plan. This plan is available from the Environment Sustainable Development Directorate (ESDD).

Territory and Municipal Services have completed lighting master plans for many inner suburbs. Lighting design shall be in accordance with the applicable suburb master plan when available. Designers should contact Territory and Municipal Services for applicable lighting Master Plans.

Lighting in heritage areas shall be designed, constructed and maintained using only the materials described in the Territory and Municipal Services Heritage Procedure in Appendix A.

Column setback dimensions from kerbs, vegetation , driveways, footpaths etc are found under clause 14.01.17 of *TAMS Territory and Municipal Services Street Lighting Specification Section 14*.

1.10.12 DESIGN CERTIFICATION

When the Department of Territory and Municipal Services is required to review the streetlighting design, designs shall be submitted to Territory and Municipal Services Asset Acceptance with the following information:-.

- Point of supply.
- Method of control of the lights.
- Voltage drop at the light positions at the end of every run (including ends of branches).
- The categories (as defined by the relevant Australian Standard) of lighting included in the design.
- For vehicular traffic (Category V) lighting, the information listed in Appendix C of *AS1158.1.1* "Documentation Required for Demonstrating Compliance with this Standard".
- For lighting in accordance with *AS/NZ1158.3.1* (Category P) provide installation design data in accordance with Clause 4.2 of *AS/NZS1158.3.1*.
- Electricity utility connection signed approval.

1.10.13 APPROVED LUMINAIRES, LAMPS AND COLUMNS

Refer to the list in Appendix A and section 10 for the approved luminaires, lamps and columns for streetlighting in the ACT. The luminaires and lamps used in the design shall be a type from the list. Should a designer propose to use an 'equivalent' manufacturer from those listed in section 10, that proposal requires a specific approval request by the designer to TAMS at design stage. Note Proposals for 'equivalents' at construction stage will not be entertained.

The selected luminaires have been determined based on luminaire performance, minimal upward light waste ratio, whole of life costs, Australian content as well as form that is complementary to the various ACT streetscapes. Territory and Municipal Services permit no other type of luminaire, lamps or columns without assessment and approval by Territory and Municipal Services. There are special areas of consideration that should be specifically noted.

Heritage Listed areas
Within Heritage listed areas luminaries, lamps and columns shall be in accordance with Territory and Municipal Services procedure in Appendix A.

Canberra Airport and South Care Heliport
The requirements of the Civil Aviation Safety Authority (CASA) shall be taken into account in the design of streetlighting within the vicinity of the Airport. Refer to the CASA document titled "Lighting in the Vicinity of Airports – Advice to Designers".

City Centre Precinct
The requirements of the ESDD City Centre Consultative committee design palette shall be complied with when installing lighting within the city precinct. See section 12.2.3.

High pressure sodium lamps shall be used for Category V lighting (Arterial Roads and Major Roads) and metal halide lamps for Category P lighting (Minor Collector Roads and pedestrian areas). There will be some exceptions. The main exceptions are as follows:

Category V lighting adjacent shopping centres
Where Category V lighting is required along a road between a shopping precinct and an adjacent car park, metal halide lamps shall be used for the Category V lighting and luminaires with full cut-off to light distribution above the horizontal shall be used. Car parks and bus interchange areas shall be illuminated using metal halide lamps.

Adjacent to Mt Stromlo observatory
Lighting within a 5km radius of Mount Stromlo Observatory shall utilise high pressure sodium lamps. This restriction also includes the entire proposed development of Molonglo.

National Capital Authority designated land.
The requirements of the National Capital Authority shall be taken into account for all types of streetlighting within areas under their planning control. Refer to the National Capital Authority when working in these areas. An indication of NCA designated lands is shown on map Appendix B.

Existing Suburb Lighting.
Where existing suburb lighting does not have a master plan covering its upgrade, lamp types shall be complimentary to the existing lamps within the suburb i.e.

- where low pressure sodium vapour exist, high pressure sodium maybe installed
- where mercury vapour lamps exist, metal halide may be installed.

1.10.14 ASSET NUMBERS

Asset numbers shall be requested from the electricity utility on successful design connection approval. The designer or contractor shall pay for the provision of asset numbers at the time of issue. Asset numbers shall appear on the design when submitted to Territory and Municipal Services Asset Acceptance for approval. The Contractor shall fix the numbers to the asset in accordance with *TAMS Territory and Municipal Services Street Lighting Specification Section 14* clause 14.5.8.

2 LIGHTING FOR TRAFFIC ROUTES (CATEGORY V LIGHTING)

2.1 PERFORMANCE CRITERIA

Refer particularly to AS/NZS 1158.1.1 Road lighting. Part 1.1: Vehicular traffic (Category V) lighting – Performance and installation design requirements, AS/NZS 1158.1.3 Road lighting. Part 1.3: Vehicular traffic (Category V) lighting – Guide to design, installation, operation and maintenance and AS 1798 Lighting poles and bracket arms – Preferred dimensions. Ensure that the design and installation is carried out in accordance with these standards.

2.2 PRESCRIPTIVE CRITERIA

Arterial roads shall be illuminated to V3 classification unless otherwise directed by Territory and Municipal Services. Lighting for Arterial Roads and Major Roads shall generally be carried out using nominal mounting height 9m, 10.5m or 12m high galvanised steel columns with 150 watt, 250watt or 400watt high pressure sodium lamps.

The preference for lighting roundabouts is from the centre of the roundabout which may require column heights greater than 12m.

Aeroscreen configurations shall be used where appropriate and where prescribed by these guidelines and shall generally be restricted to the following locations:

- Proximity to the Canberra airport and South Care Heliport.
- Streets immediately between shopping centres and adjacent carparks.
- Carparks
- Within 5km of Mt Stromlo observatory
- Where glare otherwise caused by conventional luminaires may be of particular concern.
- Roundabouts

Luminaires shall generally be mounted on outreach arms of 3m or 4.5m (0.5m for roundabouts).

Luminaires shall have integral control gear and shall be power factor corrected to 0.9 pf. Preferred control method of streetlighting on Arterial roadways is from a centralised control point with single PE cell control.

Columns shall be complete with access hatches for access to terminals and individual circuit breakers. Access covers shall be designed to face away from oncoming traffic to permit installers and maintenance personnel peripheral vision of traffic activities when working on the streetlight columns.

Frangible columns of the slip-base type shall generally be used on Arterial roads except where there is risk of injury to pedestrians (high pedestrian activity areas in close proximity to columns) in which case high speed impact absorbing frangible column types shall be used. Refer to *AS/NZS 1158.1.3* for further guidance. Slip-base columns shall have a mounting base and concrete foundation rather than a direct buried mounting stub refer drawing DS12 Category 02 and 03.

3 LIGHTING FOR PEDESTRIAN AREA (CATEGORY P)

3.1 PERFORMANCE CRITERIA

This section is applicable to roads and other outdoor public areas where the visual requirements of pedestrians are dominant. Refer particularly to *AS/NZS 1158.3.1* Road Lighting. Part 3.1: Pedestrian area (Category P) lighting – performance and installation design requirements.

Refer also to *Crime prevention and urban design resource manual* – ACT Territory and Municipal Services Planning and Land Management and various Territory and Municipal Services suburb master plans.

Ensure that the design and installation is carried out in accordance with these standards and guidelines.

3.2 PRESCRIPTIVE CRITERIA

3.2.1 COLLECTOR AND LOCAL ROADS

Collector and local roads (those defined to be lit in Category P3 and P4 of *AS/NZS 1158.3.1*) shall be illuminated using luminaires with integral control gear and that comply with *AS 1158.6* and *AS/NZS 1158.3.1*. Obtrusive lighting requirements of AS4282 –1997 shall be complied with. In particular table 2.1 shall be considered. Integrated individual PE Cells shall control luminaires. Where a separate control point is installed the luminaires shall have bridging units installed in place of where the photo-electric cell control unit would otherwise be fitted.

Local roads (Category P4) shall be illuminated using streetlights consisting of luminaires with 70 Watt metal halide lamps mounted on direct buried galvanised steel columns, 6.5 metres above the ground level on a 1.5 metre outreach. Higher wattage metal halide lamps or High Pressure Sodium (HPS) (150 watt) may be necessary to comply with the standard at locations of local area traffic management devices, collector roads etc. An exception to the use of metal halide is the area within the 5km radius of the Mount Stromlo Observatory (including all of the proposed Suburb of Molonglo) where luminaires using high pressure sodium lamps shall continue to be used for local roads.

3.2.2 PATHWAYS FOR PEDESTRIANS OR CYCLISTS

Where pathways form part of local roads, no special lighting requirements apply as suggested by the Australian Standards providing P3 levels are maintained from property boundary to property boundary. Attention shall be paid to the effects of mature vegetation planting adjacent to the pathways. Off road path types shall generally not be illuminated.

The following exceptions apply:

- Shopping Centre Precincts
  Provide pedestrian lighting consistent with crime prevention and amenity (P2). Light trunk paths on approaches to and through shopping centres.

- Underpass
  Illuminate where paths pass under roadways preferably by using column mounted lights adjacent to the approach and exits of the underpass and luminaires within the underpass as nominated in *Section 12.10.11*. Within the underpass the ceiling and upper wall sections should be a light colour and illuminated to P8.

- Medium density and cluster housing
  Where there is significant night time pedestrian movement from this type of development to shopping centres/restaurants (P2) lighting should be considered. Generally lighting shall be designed in accordance with the provisions of AS/NZS 1158.3.1, Section 2.5.3.4 Part (a) where spill light could become problematical.
  In general luminaires should be a "cut-off" type, mounted a minimum of four and one half (4.5) metres above ground level and should have high impact U.V. stable lenses. At this mounting height house shields shall be installed. Column design should be without a shoulder unless the luminaire is mounted at a minimum height of 6.5 metres and should preferably be an unpainted corrosion protected finish outside the shopping precinct. The columns may be direct buried or base plate mounted. The column shall be of adequate diameter at the base to provide sufficient rigidity and sufficient space for looping and terminating 16mm^2 single phase conductors and providing individual circuit breaker protection behind a flush mounted access hatch.

Lamps providing "white light" shall be used. The preferred lamp types are 70 watt and 150 watt metal halide (permissible luminaire types for 150W are limited). Where paths are in close proximity to residential housing luminaires with in built house shields designed to control glare shall be used.

- Open pedestrian areas, malls, arcades, town squares.
  Areas primarily for pedestrian movements shall be illuminated to P7. Luminaires should be a "cut-off" type, mounted a minimum of 4.5 metres above ground level and should have high impact U.V. stable lenses. Column design should be without a shoulder unless the luminaire is mounted at a minimum height of 6.5 metres. The columns shall be base plate mounted. The column shall be of adequate diameter at the base to provide sufficient rigidity and sufficient space for looping and terminating 16mm^2 single phase conductors and providing individual circuit breaker protection behind a flush mounted access hatch with security screw attachment. See Section 12 10**.**
  Lamps providing "white light" shall be used. The preferred lamp types are 70 watt and 150 watt metal halide (permissible luminaire types for 150W are limited). Where paths are in close proximity to residential housing luminaires with in built house shields designed to control glare shall be used.

- Carparks
  Carparks shall generally be illuminated to Categories P11(b) and P12 for dedicated disabled parking spaces of AS/NZS 1158.3.1. (Note that there may be instances where it is more appropriate to use Category 11(a) and this shall be stated in the design information provided).
  Luminaires should be a "cut-off" type mounted a minimum of 6.5 metres above ground level. Column type should be preferably unpainted galvanised steel finish, base plate and foundation mounted. Where carparks are situated in prestige locations decorative luminaires and columns indicated in TAMS Urban Infrastructure Street Lighting Specification Section 14 may be used. Column base sections shall be of adequate diameter to provide space for looping and terminating 16mm^2 three phase conductors and providing individual circuit breaker protection behind a flush mounted access hatch.
  Lamps providing "white light" shall be used. The preferred lamp types are 150W and 250W metal halide. (Note previous requirement of for the use of high pressure sodium lamps in the vicinity of Mt Stromlo and in the new Molonglo suburb).

4 LIGHTING OF PEDESTRIAN CROSSINGS

4.1 PERFORMANCE CRITERIA

Where a design is required for an uncontrolled (non-signalised) pedestrian crossing, illumination shall be provided in accordance with AS 1158.4 Supplementary lighting at pedestrian crossing.

4.2 PRESCRIPTIVE CRITERIA

Pedestrian crossing lighting shall be installed in accordance with AS/NZS 1158.

5 ROUNDABOUTS

5.1 PERFORMANCE CRITERIA

Roundabouts shall be illuminated. The preferred design arrangement for the illumination of roundabouts with a radius of 6m or more is to use a central column with outreach bracket lengths of 0.5 or 1.5 metres. i.e., 4 x 0.5m, or 4 x 1.5m brackets as appropriate.

5.2 PRESCRIPTIVE CRITERIA

Bracket lengths exceeding 0.5 metres shall not be used on a central pole. A centre-hinged column (either slip-base or energy absorbing) is preferred to a standard rigid column. A center-hinged rigid column may only be used where the radius of the roundabout exceeds 6m. Rigid non-hinged poles may be installed on roundabouts of 6m radius and greater for the purpose of installing joint use streetlight and communications towers where the responsibility for maintenance has been accepted by the communications authority.

Where central columns cannot be installed (generally on roundabout less than 6m radius) all peripheral columns installed on the departure sides of the roundabouts shall be installed at a minimum of 3m from the back of the kerb.

6 LUMINAIRES AND LAMPS USED IN THE ACT

Luminaires shall comply with the requirements of AS 1158.6. They shall be integral control gear type, power factor corrected to 0.9pf and have integral photo-electric cell control capabilities. Luminaires shall have individual circuit breaker protection inside the column. Control gear shall be of the reactive type and not constant wattage. Stepped switching and voltage regulation optioned luminaires are preferred in Cat V road luminaires. Luminaires used for post-top installation may utilise external control equipment. As many luminaries have also been selected for their form as well as function, luminaire types are restricted to those listed in Section 10.

Should a designer propose to use an 'equivalent' manufacturer from those listed in Section 10, that proposal requires a specific approval request by the designer to TAMS at design stage. Note Proposals for 'equivalents' at construction stage will not be entertained.

6.1 SPECIAL CASES

There are a number of areas that are considered to be special cases in the ACT. The designer shall seek advice from the Territory and Municipal Services when lighting design is required in these areas.
Special areas include:

- Heritage listed areas (see Appendix A).
- Lighting within a 5km radius of the Mount Stromlo observatory. All luminaries to incorporate cut off shields and be sodium.
- Lighting around Canberra airport. All luminaries to incorporate cut off shields.
- Lighting within the City precinct area. In accordance with ESDD CBD master plan.

6.1.1 COMMUNICATION COLUMNS

Where there is an agreement between a communications carrier and the ACT Government represented by ACT Planning & Land Authority, and where the column site is taken over by the carrier, the communications transmitters shall be located at a sufficient height above and away from the position of the streetlight equipment so as the communication system radiation propagation paths are clear of and enable safe work practices by streetlight maintenance personnel. Prudent design shall ensure that no part of streetlight maintenance plant, equipment or personnel shall need to encroach into the radiation path for normal streetlight maintenance activities.

Electrical separation between the communications systems and streetlights shall be maintained.

All communication columns shall have attached permanent contact information for the purpose of contacting the owners of the communications equipment should access be required for streetlight maintenance purposes.

6.1.2 COMBINES TRAFFIC SIGNAL COLUMNS

The Territory and Municipal Services Traffic Signals Manager shall approve design of this type of lighting system. Wiring of this type of installation shall be in accordance with Electrical Note 2 Electrical Installation of Street Lights, Traffic Lights, Combination Street and Traffic Lights and Public Area Lighting.

Non-combined street light columns shall not be connected to the same sub-main as the traffic signal controller.

6.1.3 ELECTRICITY UTILITY POLES

Installation of streetlighting assets on electricity utility assets may not be undertaken without written permission of the electricity utility.

6.2 RELOCATION OF EXISTING ASSETS

A design review of the lighting installation is required if a column is being relocated. Relocation of columns to an adjacent block will require written approval from the affected lessee. Standard distances shall be maintained from vegetation, roadways and driveways. Columns cannot be removed or relocated without written authorisation from Territory and Municipal Services. Where the removal is temporary suitable alternative lighting shall be installed to compensate. All relocation or removed columns shall be recorded on a WAE

drawing and submitted to Road ACT to enable the spatial mapping to be updated and the energy billing to be adjusted where necessary.

APPENDIX A HERITAGE ACT STREETLIGHTING DESIGN AND MAINTENANCE REQUIREMENTS

1. OBJECTIVE

The objective of this policy is to conserve remaining original heritage light fittings, posts and poles, and where replacement is necessary to nominate suitable modern fittings so as to achieve a uniformity of pedestrian lighting fixtures which are sympathetic to the style of original lighting in each precinct and which prevents an ad hoc approach to conservation, maintenance and replacement.

2. SCOPE

2.1 This policy relates to the conservation and replacement of all streetlighting assets in the following residential precincts as listed in the ACT Heritage Places Register

Alt Crescent	**Corroboree Park**	**Reid**
Barton	**Forrest**	**Tocumwal**
Blandfordia 5	**Kingston**	**Wakefield Gardens**
Braddon	**Red Hill**	

2.2 This policy includes all streetlighting assets in any street bounding a residential heritage precinct.

3. PROCESS

3.1 Streetlighting assets due for replacement or repair shall be checked against the Heritage Register . Items in residential heritage precincts or streets that are adjacent to heritage precincts will be identified and will trigger the use of this policy.

4. REFERENCES

4.1 Keith Baker & Associates, Canberra Street Lighting Heritage Study, report for Institution of Engineers, Canberra Division Heritage Panel, under an ACT Heritage Grant, July 1996.

4.2 R.D.Gossip Pty. Ltd., Street Furniture Assessment in Heritage Precincts, draft report to Territory and Municipal Services and Heritage Unit, Environment ACT, June 2002.

4.3 Philip Leeson Architects Pty. Ltd. , *Recommendations for Replacement of Light Fixtures in Heritage Precincts*, draft report to Heritage Unit, Environment ACT, May 2005.

5. POLICY

5.1 LUMINAIRES

5.1.1 All original light fittings shall be conserved in their existing locations.

5.1.2 Original fittings shall be properly maintained.

5.1.3. Every effort shall be made to repair existing fittings rather than replace them. Repairs shall not detract from overall appearance.

5.1.4 Every effort shall be made to upgrade existing fittings to modern technological or functional standards rather than replace them. Upgrading shall not detract from overall appearance.

5.1.5 Existing original fittings shall be replaced only where repair is technically or financially unreasonable. Replacement items shall be in accordance with the recommendations for each precinct as defined in Section 7.

5.1.6 Additional fittings deemed necessary for adequate pedestrian lighting shall be installed in accordance with this Policy.

5.1.7 Where existing original pedestrian lighting is inadequate for roadway illumination the existing fittings shall be conserved or replaced in accordance with this Policy and supplemented with modern outreach roadway lighting to meet illumination requirements.

5.2 LAMP POSTS AND POLES

5.2.1 Original lamp posts and poles shall be conserved in their existing locations.
5.2.2 Original fittings shall be properly maintained.

5.2.3 Every effort shall be made to repair existing fittings rather than replace them. Repairs shall not detract from overall appearance.

5.2.4 Every effort shall be made to upgrade existing fittings to modern technological or functional standards rather than replace them. Upgrading shall not detract from overall appearance.

5.2.5 Original fittings shall be replaced only where repair is technically or financially unreasonable. Replacement items shall be in accordance with the recommendations for each precinct.

5.2.6 Suitable National Capital (NC) Columns from outside heritage precincts shall be replaced with modern columns and stockpiled for use as replacements in heritage precincts where nominated below.

5.2.7 Where re-location of original NC Columns is judged infeasible replacement columns shall be 3.5m high tapered galvanised steel known as NCC 2005.

5.2.8 Original Federal Capital Commission (FC) Columns are extremely rare and shall be conserved in their existing locations for as long as possible. They are known to exist outside Manuka Pool (pair), Griffith, outside Screen Sound, Acton (pair) and one fitting in Murray Crescent, Griffith. When replacement is unavoidable stockpiled original NC Columns shall be installed. Where more than one original FC column is found at a particular place and one requires replacement, all columns shall be replaced regardless of condition.

5.2.9 Existing timber poles shall be retained and replaced, when necessary, with the same.

5.2.10 Existing non FC and NC columns shall be replaced, when necessary, with 3.5m high tapered galvanised steel known as NCC 2005. If higher than 3.5m then available columns of the required height shall be used.

6. FITTINGS SCHEDULE BY PRECINCT

The following schedule is the Policy for replacement of light fittings, posts and poles for each heritage precinct when replacement is permitted under this Policy.

Numbered alternatives indicate priorities described in 5.2.6 and 5.2.7.

Precinct	**Luminaire**	**Support**
Alt Crescent	Darwin Canopy Lantern	1. Relocated original NCC column 2. NCC 2005
Barton	Darwin Canopy Lantern	1.Relocated original NCC column 2.NCC 2005
Brassey House	Relocated original or reproduction brass lantern subject to approval by Heritage Council	Original NCC column
Blandfordia 5	Darwin Canopy Lantern	1.Original NCC column relocated 2.NCC 2005

Precinct	**Luminaire**	**Support**
	Modern outreach arm	Timber or steel pole depending on existing being replaced
		Conserve FCC column in Murray Crescent
Braddon	Reproduction Radial Wave on decorative steel bracket	Timber pole
	Supplementary modern roadway lighting where Category V required	Steel outreach arm
	Conserve reproduction lanterns at Gorman House	Relocated original NCC Columns
Corroboree Park	Reproduction Radial Wave on decorative steel bracket to park perimeter and opposite sides of bounding streets.	Timber pole
	Selected modern outreach arm elsewhere	Timber or steel pole
Forrest	Darwin Canopy Lantern	1.Original NCC column relocated 2.NCC 2005
	Selected modern outreach arm	Timber or steel pole
Kingston	Selected modern outreach arm	Timber or steel pole
Red Hill	Darwin Canopy Lantern	1.Original NCC column relocated 2.NCC 2005
	Selected modern outreach arm	Timber or steel pole
Reid	Reproduction Radial Wave on decorative steel bracket	Timber pole
	Darwin Canopy Lantern	1.Original NCC column relocated 2.NCC 2005
	Selected modern outreach arm	Timber or steel pole
Tocumwal	Darwin Canopy Lantern	1.Original NCC column relocated 2.NCC 2005
	Selected modern outreach arm	Timber or steel pole
Wakefield Gardens	Selected modern outreach arm	Timber or steel pole

Trunk Road Infrastructure Standard No. 02

ROAD DESIGN

Supplement to Austroads Guide: Road Design

Attachment B

PEDESTRIAN & CYCLIST FACILITIES

CONTENTS

1 INTRODUCTION

This document sets out the requirements to be used by practitioners in the planning and design of pedestrian and cycling facilities in the ACT.

The principal requirements are contained in the *Reference Documents listed* in Section 2.

All relevant design principles contained in the reference documents except where noted in this Specification are to be integrated in the design and planning of pedestrian and cycling facilities and the associated infrastructure.

This specification is to act as a technical support for the *Key Reference documents*. It aims not to repeat information already contained in these documents but to act as a supplement including elements of design and requirements that are specific to the ACT.

The Australian Road Rules are enforced in the ACT and practitioners should not design or allow installation of any facility that requires or encourages road users to contravene an Australian Road Rule.

1.1 BEST PRACTICE DESIGN

The Guidelines for the preparation of Estate Development Plans provides a performance-based approach to the design of new facilities without detailing planning and design requirements, these are provided mainly through *GRD Parts 3, 4, 4A, and 6A*.

Given that the ACT is a small jurisdiction and an island within NSW, the *NSW Bicycle Guidelines* have been adopted for use in the ACT to provide supplementary design guidance to GRD Part 3, 4 ,4A and 6A. Supplementary planning guidance should be from the NSW Government - *Planning Guidelines for Walking and Cycling* where applicable. The use of NSW guidelines to supplement the other accepted guidelines is to encourage a more standardised approach to the planning and design of bicycle and pedestrian facilities through more detailed guidance and examples of acceptable planning and design solutions.

Reference to guidelines and notes from other jurisdictions to aid in a better understanding of the design of safe and innovative solutions is also encouraged.

Local bicycle and pedestrian user groups can be a valuable source of information to aid the Practitioner in the planning and design of bicycle and pedestrian facilities. To aid in the promotion of best practice design, the Road Authority generally requires that the Practitioner engage with user groups as part of the design and planning process in the provision of new and gifted cycle infrastructure assets. Refer to Section 5.5 for the requirements regarding consultation with user groups.

1.2 ACT CONTEXT

The ACT varies from NSW in the approach to the provision of bicycle facilities in a number of key areas that require consideration in the use of the NSW Bicycle Guidelines as follows:

- All off-road paths including on-street footpaths are a shared facility for pedestrians and cyclists in the ACT. This differs from NSW, where cyclists over 12 years of age are not permitted to ride on footpaths.
- Canberra is a planned city and has a good network of shared paths. However, for faster moving more experienced cyclists who may require a more direct route free of pedestrians and loss of right of way at road crossings, provision of on-road cycling options may be preferred. Due to topography and through design, Canberra does not have a grid or radial street pattern as in other Australian cities and arterial roads are generally the only roads to provide these direct routes. These roads generally have speed limits up to 80km/h and are designed to a high standard generally with controlled access, clearly defined intersections, good sight distances and a much lower volume of heavy vehicles compared to similar roads in other jurisdictions. This is not consistent with the NSW context and Figure 3.2 of the NSW Bicycle Guidelines does not apply in the ACT.
- Linemarking types used in the ACT are to be in accordance with Trunk Road Infrastructure Standard 03 – Traffic Management, Attachment B - Traffic Control Devices.
- Directional signage should be in accordance with this specification. Behavioural and regulatory signage detailed in the NSW Bicycle Guidelines may be utilised.

- Parallel parking space width is set at a minimum of 2.3m with an allowance of 0.5m for car door opening to be outside of the traffic lane, with an allowance made for cyclists. Parallel parking is limited to roads with a speed limit of up to 60km/h.
- Hook turns are permitted in the ACT and installation of a bicycle lane between a right turn lane and a traffic lane would not generally be acceptable.

1.3 ACT POLICIES

Cycling and walking are supported by the ACT Government and are recognised as healthy, low cost and environmentally friendly forms of transport. The ACT Government has adopted the National Strategy for Ecologically Sustainable Development and the National Greenhouse Strategy. Both of these strategies support an increase in commuter cycling and walking in favour of private car use. Recreation policies also strongly support walking and cycling as a means of improving community health and fitness, and of helping to reduce greenhouse gas emissions and vehicle-produced noise and air pollution.

The Sustainable Transport Plan for the ACT lists targets and actions to increase walking and cycling as sustainable modes of transport in the ACT. The plan aims to increase the journey to work modal split to 7% for cycling and 7% for walking by 2026. A key action of the plan is to develop a master plan for trunk cycle routes, and develop cycling routes and paths to provide an integrated cycling network, including on-road and off-road cycling opportunities. This has commenced, and a Main Routes Network has been developed and is illustrated in standard drawing DS13-11.

It is ACT Government policy to provide on-road cycling lanes on all new arterial roads and consider retrofit of on-road cycle facilities when undertaking maintenance such as resurfacing works that involves eradication and reinstatement of linemarking on arterial roads. All new road projects including gifted assets are to provide for the needs of cyclists and pedestrians in the design of signposting, linemarking and traffic arrangements with particular regard to the Main Routes Network.

ACT Government policy on walking and cycling is subject to change and the Practitioner should check as to current policy whenever planning or designing a project.

2 REFERENCE DOCUMENTS

2.1 LEGISLATION

The key reference legislation is:

Road Transport (Safety & Traffic Management) Act 1999
Road Transport (General) Act 1999
Disability Discrimination Act 1991
Australian Road Rules, National Road Transport Commission.

2.2 GUIDELINES

There are many instances within the series of Austroads Guides where advice is provided on facilities for pedestrians and cyclists. The key reference Guides and Parts \ in this respect are as follows:
Austroads Guide to Road Design (GRD):

- Part 3 – Geometric Design
- Part 4 - Intersections
- Part 4A – Signalised and Unsignalised Intersections
- Part 4B – Roundabouts
- Part 6A – Pedestrians and Cyclists

Austroads Guide to Traffic Management (GTM):

- Part 5 – Road Management
- Part 6 – Intersections, Interchnages and Crossings
- Part 8 – Local Area Traffic Management

Cycling Aspects of Austroads Guides. Report AP-G88-11, Austroads 2011.
(This report contains information that relates to the planning, design and traffic management of cycling facilities and is sourced from Austroads Guides, primarily the Guide to Road Design, the Guide to Traffic Management

and the Guide to Road Safety. The report has been produced to provide readily available information for practitioners who have a specific interest in cycling issues and facilities.)
NSW Bicycle Guidelines. Roads and Maritime Services, NSW (formerly Roads and Traffic Authority, NSW).
ACT Government, *Estate Development Code (draft) DV306*
NSW Government - *Planning Guidelines for Walking and Cycling.*
http://www.canberraconnect.act.gov.au/transroadstraffic/roadsafety/roadrules/australianroadrules.html
Guidelines for the preparation of Estate Development Plans, ACT Planning and Land Authority
http://www.actpla.act.gov.au/
ACT Crime Prevention and Urban Design Resource Manual, ACT Planning and Land Authority.
http://www.actpla.act.gov.au/publications/crime_prevention/ResManual.pdf
Civic Accessibility Study - Volume 3, Department of Urban Services
http://www.parksandplaces.act.gov.au/policiesandpublications/civicaccessstudy
Canberra Bicycle 2000 Strategy, ACT Planning and Land Authority.
http://www.actpla.act.gov.au/bikebits/bike_files/bikpla.htm
The Sustainable Transport Plan for the ACT, ACT Planning and Land Authority.
http://www.actpla.act.gov.au/transportplan
National Greenhouse Strategy, Australian Greenhouse Office
http://www.greenhouse.gov.au/government/ngs/index.html
Australian National Cycling Strategy 2005-2010,Australian Bicycle Council
http://www.abc.dotars.gov.au
The Canberra Spatial Plan, ACT Planning and Land Authority
http://www.actpla.act.gov.au/plandev/sp-intro/index.htm
NSW Bicycle Guidelines, Roads and Maritime Services, NSW -.
http://www.rta.nsw.gov.au/trafficinformation/downloads/nswbicyclev12_i.pdf
Vicroads Cycle Notes, VicRoads
http://www.vicroads.vic.gov.au/
Queensland Cycle Notes, Queensland Transport.
http://www.transport.qld.gov.au/qt/LTASinfo.nsf/index/cycling_notes
The Bicycle Parking Handbook, Bicycle Victoria
http://www.bv.com.au

2.3 STANDARDS

AS 1428 Design for Access and Mobility, Part 1 – General Requirements for Access – Buildings, Standards Australia.
AS 1428 Design for Access and Mobility, Part 4 – Tactile Ground Surface Indicators, Standards Australia.
AS 1657 Fixed Platforms, Walkways, Stairways and Ladders. Design, Construction and Installation, Standards Australia.
AS 1742.1 – 2003 Part 1: General introduction and index of signs, Standards Australia.
AS 1742.2 – 2003 Part 2: Traffic control devices for general use, Standards Australia.
AS 1742.9 Manual of Uniform Traffic Control Devices, Part 9 – Bicycle Facilities, Standards Australia.
AS 1742.10 Manual of Uniform Traffic Control Devices, Part 10 – Pedestrian Control and Protection, Standards Australia.
AS 1742.13 Manual of Uniform Traffic Control Devices, Part 13 – Local Area Traffic Management, Standards Australia.
AS 2890.3 Bicycle Parking Facilities, Standards Australia.

3 OBJECTIVES

This document aims to provide practitioners with a suite of planning considerations and design measures to ensure a consistent approach is maintained in the provision of pedestrian and cycling facilities.

Criteria that detail the performance requirements for the provision of pedestrian and cycling facilities as part of new developments are contained in the Guidelines for the preparation of Estate Development Plans.

The off-road paths and on-road facilities are an integral part of the overall community transport network. The off-road paths should provide a network of primarily pedestrian facilities to provide generally low speed and volume routes for cyclists with connections to adjoining streets, open spaces, activity centres and the greater trunk path and Main Routes Network. Cyclists must give way to pedestrians on off-road facilities and on-road facilities are provided for faster moving more experienced cyclists.

Both on and off-road facilities should be planned and designed with careful consideration of the *key design principles* (refer Section 6) and provide the level of amenity suitable for all of the anticipated user groups including users with limited mobility and parents with prams. The provision of the facilities should encourage pedestrian activities and cycling for transportation and recreational purposes to be undertaken safely and conveniently. This specification details a hierarchy of facilities particular to ACT conditions with a higher level of amenity to be provided on Main Routes to reflect the potential higher usage and function of these routes.

Through good planning, design and construction practices, a pedestrian and cycling network that is cost effective in terms of both capital expenditure and on-going maintenance costs will be delivered to the ACT community.

4 PEDESTRIAN AND CYCLE NETWORK

4.1 GENERAL

The pedestrian and cycle network is made up of on-road and off-road facilities. Details of the requirements for off-road paths that are for use by both pedestrians and cyclists are included at Section 6.3. On-road facilities are for use by cyclists only and include bicycle lanes, wide marked shoulders and wide kerbside lanes. Details of on-road cycling facilities are included at Section 6.4.

The pedestrian and off-road cycle network in the ACT context includes all paths as cyclists of all ages are permitted to use any path in the ACT. This is consistent with the Australian Road Rules, however unlike NSW, the ACT does not have additional laws that limit the use of footpaths by cyclists.

4.2 MAIN ROUTES NETWORK

A defined main pedestrian and cycling network has been developed and will be reviewed regularly to promote an efficient system to best serve and encourage pedestrians and cyclists. A hierarchy of facilities to best suit different user groups has been developed through public consultation and is to be implemented over time through retrofit and wherever new facilities are provided. Providing a choice in facilities to cater for the needs of different user groups will also contribute to reaching the Sustainable Transport Plan's transport mode share targets for walking and cycling journeys to work.

The Main Routes Network provides a higher level of amenity and links key destinations such as town centres and major employment areas. Other paths including Minor, Intermediate and Trunk paths (refer Table 6.1) feed in to the Main Routes to form a coherent network.

The Main Routes Network is made up of two mutually independent networks, namely Main Community Routes and Main On-Road Routes. Connector Routes provide for linkage between these main routes and where provision of an off-road path is not possible or cyclist volume requires more alternative main routes. Another type of Connector Route exists where local access streets have been used in lieu of a Trunk path in the Main Community Routes network. These are generally missing links in the network but may be marked as Connector Routes due to the infeasibility of providing a Trunk path in some locations due to verge widths and mature trees.

The Main Routes Network has been designed such that the users of Main Community Routes will not be required to use Main On-Road Routes to complete a journey.

Transport Planning Branch of Environment and Sustainable Development Directorate (ESDD) is currently undertaking a strategic plan titled ACT Strategic Cycle Network Plan. This study will review the Main Route Network and recommend a Strategic Main Route Network Plan. Standard Drawing DS13-11 will be updated after completion of this project.

4.3 MAIN COMMUNITY ROUTES

This network is an off-road network made up of Trunk paths, and is provided for walkers and joggers as well as recreational, school and less confident cyclists. Pedestrians have right of way on these routes and with higher pedestrian volumes these paths may become unsuitable for faster moving cyclists. Maintaining right of way for the path user is an important consideration on these routes to assist in the reduction of journey times.

A higher level of amenity is to be provided on these routes, including:

- Higher standard of signage (refer Section 7) including destination, location and behavioural signage as appropriate
- Right of way to be provided at driveways and roadway accesses to leased land wherever safe and practicable refer to standard drawing DS-06 for an example of an acceptable driveway crossing treatment
- To maximise right of way opportunities, path priority crossings should be considered where appropriate (refer Section 6.11)
- Lighting of higher volume routes
- High priority given to removing any missing links in this network

4.4 MAIN ON-ROAD ROUTES

This network is an on-road network for use by more experienced, faster-moving cyclists such as commuters, and touring and training cyclists wanting to get to a destination quickly with a minimum loss of right of way. These routes are generally on arterial roads and are suitable for more experienced cyclists comfortable with riding adjacent to vehicular traffic.

A higher level of amenity is to be provided on these routes including:

- Priority installation of bicycle lanes whenever possible to remove missing links
- Use of marked shoulders in retrofit to promote greater connectivity (refer Section 6.5.3) where installation of a bicycle lane is not possible
- Continuation of facilities including marked shoulders through intersections (refer Section 6.5.3)
- Removal of devices (such as off-road diversions that require cyclists to dismount), or of any other delay points from this network, where it is safe to do so
- Provision of ramps to the appropriate specification to allow good connectivity to Main Community Routes and other off-road facilities, especially at destination nodes

4.5 CONNECTOR ROUTES

Connector Routes are generally local access or collector streets as well as off-road path links that provide connectivity in the Main Community Routes network where it may not be possible or economically feasible to construct a trunk path. They may also provide an alternative route to Main On-Road Routes other than arterial roads on high volume routes.
A higher level of amenity is to be provided on these routes including:

- Higher standard of signage (refer Section 7) including directional and reassurance signs, as appropriate
- Pavement marking to reinforce route as used more frequently by cyclists (refer Section 6.4.3)
- Widening of path links as appropriate
- Improved street lighting

5 PLANNING OF PEDESTRIAN AND CYCLING FACILITIES

5.1 CONTEXT

Walking and cycling are important means of getting to destinations across Canberra as they assist in reducing peak vehicular travel demand, fossil fuel use and greenhouse gas emissions, as well as improving health. These modes also work to improve accessibility and transport equity.

Provision of appropriate infrastructure plays a key role in the implementation of the Sustainable Transport Plan, which aims, among other things, to ensure that cyclists and pedestrians have facilities provided at an appropriate standard to create safer and attractive walking and cycling environments.

The provision of pedestrian and cycling facilities and their ongoing maintenance in the ACT is a very significant task for Government. This should be balanced against providing a level of amenity that will encourage people to walk and cycle and achieve the transport mode share targets of the Sustainable Transport Plan. Therefore every effort should be made to minimise costs whilst meeting the design objectives and performance requirements.

Issues that need to be addressed in the preliminary design and planning phases include the following:

- Compliance with the "desirable" requirements of the *Key Reference* documents and this specification for all new facilities. Use of "minimum" requirements should only be considered for retrofit of facilities (refer Section 6.1).
- All new neighbourhoods should be walking and cycling friendly by following the *key design principles* outlined in Section 6.1.
- Pathways should address the requirements of people with disabilities including access to public transport with connecting paths and suitable crossing points to allow suitable access to bus stops.
- Avoid providing pathways where there are no "desire lines".
- Design pathways appropriately to suit the environment, eg. paths in open spaces.

Based on the experience of the Road Authority, the following represent areas of special concern and are to be taken into account by Practitioners at an early stage of the design process:

- Missing path elements.
- Unsafe conditions:
  - encroaching bushes
  - blind spots
  - clearances to objects
  - path damage by vehicles and tree roots
- lighting
- signage
- drainage

5.2 NETWORK PLANNING

The Planning Authority provides strategic network planning for pedestrian and cycling facilities in new and developing residential areas. This will usually take the form of plans and documents such as:

- Preliminary Assessment
- Structure Planning
- Concept Planning
- Site Investigation Report
- Implementation, Estate Development and Development Approval Plans

Practitioners should ensure that paths comply with strategic planning requirements and the planning guidelines contained in the Key Reference documents (refer Section 2). The connectivity of new paths and main routes should also be checked against the Main Routes network, refer standard drawing DS13-11.

If there is a need to modify path networks in detailed design, for economic reasons for instance, Practitioners should liaise with the Planning Authority on the acceptance of such modifications.

The requirements for the provision of paths in urban street reservations are indicated in the Guidelines for the preparation of Estate Development Plans. Generally paths are required where traffic volumes exceed 300 vehicles per day. However, to promote walking and cycling in new neighbourhoods, paths should generally be provided on all streets. Provision of paths on both sides of streets should also be considered in areas of higher density, higher pedestrian traffic or close to community or commercial centres.

The urban structure planning for a suburb should include the need and location for any requirement for grade separated crossings of arterial roads.

Refer to Trunk Road Infrastructure Standard 02 – Road Design, Attachment A – Street Lighting, and Trunk Road Infrastructure Technical Specification No.12 – Street Lighting, for requirements for lighting of off-road paths and pedestrian underpasses.

5.3 PATH FACILITIES IN ESTABLISHED AREAS

The Road Authority is responsible for the planning, design and upgrade / retrofitting of pedestrian and cycling facilities in established areas. These facilities are provided on a needs basis through an evaluation process that includes review of existing networks and identification of missing links, community requirements and concerns. A warrant system including a database has been developed for paths and is maintained by the Road Authority to prioritise projects to meet budget requirements. The approval of designs for paths and on-road cycle facilities is the responsibility of the Road Authority.

5.4 ON-ROAD CYCLING

As part of encouraging cycling, provisions should be made in the planning and design stages to facilitate this mode of transport. Such provisions should include identification of appropriate road widths (Table 6.2), links to the Main Routes network, Connector Routes and other off-road paths, and detailed arrangements that do not diminish the performance, function and safety of the facility. Careful consideration of the *key design principles* (refer Section 6.1) should always be undertaken as part of the planning process.

Whilst the provision of multi-lane roundabouts can be suitable for motorists, they typically create a hazard for cyclists (refer NSW Bicycle Guidelines Section 7.2.6). Potential conflict points should be carefully considered and coloured pavement treatment used where appropriate (refer Section 6.6). Use of multi-lane roundabouts as an intersection type should generally not be considered where higher volumes of pedestrians and cyclists are expected without use of grade separated or signalised crossing points.

5.5 COMMUNITY ENGAGEMENT

The ACT Government encourages practitioners to engage the community in the planning and design of both new facilities and the upgrade or alteration to existing facilities.

The local group representing general cycling interests is Pedal Power Inc. and the ACT Veteran and Canberra Cycling Clubs represent training and racing cyclists' interests. The local Bicycle Advisory Group (BAG), which includes these groups, meets regularly with the Road Authority to discuss general issues and provision of facilities. The Practitioner should consult with Pedal Power Inc. at least, in the provision of new and gifted cycle infrastructure assets.

The Road Authority may also require that Practitioners consult with pedestrian user groups or other groups. Other groups may include those representing the interests of traders when paths are being considered near shops or elderly persons' homes or schools when paths are being considered near to these facilities.

Practitioners should generally engage directly with the relevant groups or seek advice from the BAG through the Road Authority for bicycle facilities if considered necessary.

6 DESIGN OF PEDESTRIAN AND CYCLE FACILITIES

6.1 DESIGN PRINCIPLES

Provision of pedestrian and cycling facilities should incorporate the following *key design principles* (replaces NSW Bicycle Guidelines Table 3.1):

- Coherence
  - *Easy to find and follow*: signage location and clarity.
  - *Consistent quality*: minimal quality changes.
  - *Freedom of route choice*: provide level of service applicable to different user groups.
  - *Continuity*: no breaks, connectivity to other paths.
- Directness
  - *Actual cycling speed*: design speed, number of crossings and right turns required.
  - *Delay times*: crossing types, loss of right of way.
  - *Detour distances*: direct distance versus actual walking or cycle travel distance, desire lines.
- Safety
  - *Conflict points*: crossing types, pedestrian /cyclist traffic, modal conflict, exposure length to threat.
  - *Threat risk*: geometric design, sight distance, driveways, door openings, traffic speed differentials, treatment at underpasses, landscape encroachments.
  - *Target user experience level*: on-road for commuters and more experienced users, off-road for recreational and less experienced users.

- Attractiveness
  - *Community support*: consider target user group, ownership.
  - *Environment:* outlook, open appearance, lighting, appropriate landscaping.
  - *Perception of social safety*: passive surveillance, lighting, risk of vandalism.
  - *System coherence:* door to door, connectivity to other modes.
- Comfort
  - *Smoothness of ride:* surfacing, edges, jointing, trip hazards.
  - *Gradient:* minimise steep climbs, kerb ramp configuration.
  - *Obstructions:* illegally parked / loading vehicles, driveways, poles, signage, street furniture.

6.2 DESIGN CRITERIA

The *Key Reference* documents in many cases may indicate a range of criteria for a particular requirement. Practitioners shall, in general, adopt the "desirable" criteria specified. The exceptions are:

- The "minimum" or "absolute minimum" criteria may only be adopted where it can be demonstrated that there are significant disadvantages in the use of the "desirable" criteria such as in retrofit of facilities. Such considerations must be discussed with the Road Authority and endorsement obtained prior to submitting the design for approval.
- Minimum clearances may not be applicable in cases where road and open space planning provides ample space for paths to be located with greater separations to trees, kerbs, fences, etc.

It may be appropriate to adopt a higher level than the "desirable" criteria where this provision does not impose an added cost burden on either construction or on-going maintenance.

6.3 OFF-ROAD PATHS

6.3.1 OFF-ROAD PATH TYPES

The *Key Reference* documents sometimes describe path and cycleway types using conflicting nomenclature. The off-road path types detailed in Table 6.1 are defined for use in the ACT.

Table 6.1 Off-Road Path Types

Type	Common Term	Function	Width
Minor Path	Footpath	Pedestrian and cyclist use; low volumes, local access.	1.2 m
Intermediate Path	Shared Use Path, Minor Cyclepath, Wide Path	Pedestrian and cyclist use: low volumes; commuting and local access; cyclists passing in opposite directions is rare.	2.0 m
Trunk Path	Shared Use Path, Cyclepath, Cycleway, Bike Path, Trunk Path	Pedestrian and cyclist use: two way cyclists are common; commuting and local access: speeds 20 km/h.	2.5 m
Trunk Path (High use)	Shared Use Path, Cyclepath, Cycleway, Bike Path, Trunk Path	High levels of pedestrian and cyclist use in both directions: commuting; speeds greater than 30 km/h.	3.0 m

Under the Australian Road Rules all off-road paths in the ACT can be used by pedestrians and cyclists.

Pedestrians and users of wheelchairs, including motorised wheel-chairs have right of way over cyclists and users of wheeled recreational devices including roller blades, roller skates and skateboards.

6.3.2 TRAFFIC CONTROL DEVICES – OFF-ROAD PATHS

Practitioners shall provide adequate sign posting and linemarking for Trunk paths. Trunk paths shall be provided with a white centre-line (B6 or S3, refer to Trunk Road Infrastructure Standard 03 – Traffic Management, Attachment B - Traffic Control Devices) to encourage users to keep left (refer also standard drawing DS13-01).

Signs and pavement markings for Trunk paths shall comply with AS1742 and the requirements included in Trunk Road Infrastructure Standard 03 – Traffic Management, Attachment B - Traffic Control Devices. Signage on Main Community Routes shall be in accordance with Section 7.

Where a Trunk path is required to incorporate a vehicle restriction device, the design details shall comply with standard drawing DS13-02. The *3.0m Deflection Rail* should generally be used on Intermediate Paths while the *motor vehicle restriction point,* should be used on Trunk paths and Main Community Routes.

Refer to standard drawing DS13-03 for details of provisions for pedestrians and disabled persons at bus stops.

6.4 ON-ROAD CYCLING

6.4.1 ON-ROAD CYCLING FACILITY TYPES

GRD 03 and the NSW Bicycle Guidelines provide detailed descriptions, widths and pavement marking for on-road cycling treatments.

Table 6.2 provides a summary of the on-road cycling provisions required on new roads. The prescribed provisions may not apply in all cases and in such cases Practitioners should also consider the criteria above and the design solutions detailed in the Key Reference documents.

Table 6.2 On-Road Cycling Provisions for New Roads

Road	Speed Environment	On Road Cycling Provision
Local Access Streets to Minor Collector Streets	40 – 60 km/h	Shared use of road pavement.
Major Collector Street (single or dual carriageway)	60km/h	Wide kerbside lanes, desirable 4.2m. Bicycle lane may be installed with consent of the Road Authority
Arterial (first stage – single carriageway)	80km/h	1.8m bicycle lanes, 3.5m traffic lanes (10.6m wide pavement)
Arterial (dual carriageway)	80km/h	2.0m bicycle lanes, 2 x 3.5m traffic lanes, both carriageways (9.0m wide pavement)
Parkway	100km/h	2.5 - 3.0m bicycle lane, 2 x 3. 5m traffic lanes, 0.5-1.0m wide median shoulder (10.5-11.0m)

In Town Centres and industrial / commercial areas, provision for on-road cycling facilities should be carefully addressed noting the particular traffic environment such as low speed, high volumes, parking, increased commercial vehicle traffic and frequent stopping and turning movements. Whilst road widths will often be determined by these factors rather than by special provision for on-road cycling, Practitioners should note requirements at intersections and crossings in particular.

6.4.2 TRAFFIC CONTROL DEVICES – ON-ROAD CYCLING FACILITY

Signage and pavement marking for any on-road cycling facility shall be in accordance with the following shown in order of precedence:

1. The drawings associated this document (refer Section 9)
2. Trunk Road Infrastructure Standard 03 – Traffic Management, Attachment B - Traffic Control Devices and associated drawings
3. The *Key Reference* documents

Signage on Main On-Road Routes and Connector Routes shall be in accordance with Section 7.

6.4.3 CONNECTOR ROUTES PAVEMENT MARKING

On Connector Routes, bicycle pavement markings (refer standard drawing DS9-02) are to be marked on streets 100mm from the kerb lip at a maximum spacing of 200 metres, and after each street intersection. Markings should be placed where they are at low risk of being obscured, such as in front of driveways.

Symbols should be offset on each side of the road such that symbols will generally alternate on either side of the road to a maximum spacing of 150 metres.

Where Connector Routes utilise off-road paths as part of the route both bicycle and pedestrian pavement symbols (as shown in GRD Part 4, figure 9.8) are to be installed at the commencement of the off-road path section. Refer standard drawing DS13-13 for an example off-road path pavement marking arrangement.

Connector Routes that form missing Trunk path links in the Main Community Route network are to be marked as above and pedestrian pavement symbols may be utilised as appropriate to indicate footpaths carry a higher volume of pedestrians than may be perceived by their width.

6.4.4 RRPMs

Raised Retroreflective Pavement Markers (RRPMs) may be used to assist in the delineation of bicycle lanes and to deter motorists from cutting into a bicycle lane on bends or other locations. Use of red RRPM's spaced at between 2 to 5 metres placed on the outside of a B1 Barrier line (refer standard drawing DS09-01) is recommended for this purpose.

RRPMs are not to be placed within the bicycle lane as they can cause a danger to cyclists and should not be placed within pedestrian movement corridors.

6.4.5 ON-ROAD CONNECTION TO OFF-ROAD SYSTEM

Connections between the on-road and off-road systems should be provided wherever possible. On Main Routes the appropriate ramp type to suit the type of on-road facility should be provided in accordance with standard drawing DS13-05. Other ramps should be provided in accordance with Austroads Cycling Aspects of Austroads Guides Section 4.4.3.

If a bicycle lane or marked shoulder exists on the section of road where the ramp is to be positioned, the bicycle lane or marked shoulder is to continue through the ramp with a continuity line marked along the road edge to indicate the priority of the on-road facility. Any termination of a bicycle lane or marked shoulder associated with ramps should be in accordance with Section 6.8.

6.4.6 TREATMENT AT ROUNDABOUTS

The operating requirements of bicycle riders should always be considered in the design of roundabouts. A discussion of treatments and a number of design solutions applicable to roundabouts are provided in Austroads Cycling Aspects of Austroads Guides Section 5.5. The following section supplements or amends treatments shown in that document in response to the local conditions found in the ACT. Refer to Section 1.2 for a discussion of the specific conditions in the ACT that are different from those in NSW and also to some extent from those in other urisdictions.

Table 6.3 provides guidance for the provision of treatments for pedestrians and cyclists at roundabouts in the ACT based on street type, speed environment and the function of the intersecting streets within the Main Routes Network. The necessary treatment should be considered firstly in the context of both the on-road and off-road networks and the provisions for crossings for pedestrians and off-road cyclists; and secondly with how these users will share paths with potentially faster-moving cyclists who have exited from the on-road environment where they are provided with connections or diverted to off-road paths at roundabouts.

The treatments listed in Table 6.3 relate to the approach to, through and departure from a roundabout for the appropriate street types within the road hierarchy. To assist in the selection of treatments for a roundabout at an intersection between roads / streets of differing types when combined with differing functions within the Main Routes Network, the standard drawings and Table 6.3 provide guidance based on the following considerations:

- Provision of a bicycle lane within the circulating roadway is related to the approach speed of the incoming vehicle and the desire to move the line of a circulating cyclist away from the left pavement edge for a better view by drivers approaching on roads with an approach speed of 70km/h and above. This provision is related to the greater diameter of the circulating roadway required by the higher speed and thus the positioning of a circulating cyclist further away from the approaching drivers' field of view. A bicycle lane is not permitted within the circulating roadway for a roundabout with an approach speed of 70km/h and above.
- Provision of a bicycle lane within the roundabout may improve drivers' awareness of the possible presence of cyclists and provides some separation of cyclists on roundabouts with approach speeds of 60km/h or less.
- The difficulty of the right turn movement for cyclists on multi-lane roundabouts.
- The loss of right of way resulting from an on-road cyclist moving to the off-road path to make a right turn (4 vehicle and up to 6 pedestrian conflict points compared to 2 vehicle conflict points if on-road, namely lane change and give way).

- Additional width of the off-road paths to address the risks of faster-moving cyclists mixing with pedestrians on off-road paths where appropriate.
- Provision of a bypass lane or path on the through carriageway of three-legged roundabouts.

Table 6.3 Provision of cycling and walking treatments at roundabouts

Speed environment of approach leg	**ST: Street type VU: vehicle usage NL: Number of circulating lanes**	**Pedestrian and cycling network function**	**Facility provision guidance C: Cycling P: Pedestrian**
50km/h or less	ST: **local access street** VU: local access where residential environment is dominant NL: single lane	Local pedestrian and cyclist use; low volumes	**Refer *CAAG Figure 5.18* and *std drg DS13-07*** C: No specific provision P: Path crossings
		Identified Connector Route, higher pedestrian and cyclist usage; refer *std drg DS13-11*	**Refer *std drg DS13-07*** C: Mark symbols and include signage as per Sections 13.6.4.3 & 13.7.4 P: As per above
	ST: **minor collector streets** VU: collects traffic from local access, may carry buses NL: single lane	Local pedestrian and cyclist use; low volumes, predominantly local vehicle access	**Refer *CAAG Figure 5.18* and *std drg DS13-07*** C: No specific provision P: Path crossings on all legs
		Identified Connector Route, higher pedestrian and cyclist usage; refer *std drg DS13-11*	**Refer *std drg DS13-07*** C: Mark symbols and include signage as per Sections 4.3 & 7.4 P: As per above
50km/h – 60km/h	ST: **major collector street** VU: links from suburban areas to arterial roads – generally low numbers of heavy vehicles likely to carry buses NL: single lane	Link to local shops, schools and Main Onroad Routes etc	**Refer *std drg DS13-08*** C: May include bicycle lane on approach, through and departure P: Path crossings on all legs
		Identified Connector Route; refer *std drg DS13-11*	**Refer *std drg DS13-08*** C: As per above except coloured pavement treatment to be included. P: As per above
	ST: **arterial road** VU: traffic volumes generally 6–10,000vpd, usually urban NL: single lane	Connectivity between town and group centres	**Refer *std drg DS13-08*** C: May include bicycle lane on approach, through and departure P: Path crossings on all legs
		Identified Main On-road Route; refer *std drg DS13-11*	**Refer *std drg DS13-08*** C: As per above, separation island may be installed to encourage lane conformance or when heavy vehicle numbers are > 8% P: As per above
	ST: **arterial road** VU: traffic volumes generally greater than 10,000vpd, usually urban NL: two lanes	Connectivity between town and group centres	**Refer *std drg DS13-08*** C: Bicycle lane to be provided with coloured pavement treatment on approach, through and departure P: Path crossings on all legs
		Identified Main On-road Route; refer *std drg DS13-11*	**Refer *std drg DS13-08*** C: As per above, separation island may be installed to encourage lane conformance or when heavy vehicle numbers are > 8% P: As per above
70km/h or greater	ST: **arterial road** VU: traffic volumes generally 6–10,000vpd,	Connectivity between town centres and highways, experienced users only	**Refer *std drg DS13-08*** C: Provide off-road shared path, ramps and bicycle lane termination as shown on *std drg DS13-05*

Speed environment of approach leg	ST: Street type VU: vehicle usage NL: Number of circulating lanes	Pedestrian and cycling network function	Facility provision guidance C: Cycling P: Pedestrian
	controlled access / single lane		P: Path width to allow for shared provision with faster-moving cyclists from on-road
		Identified Main On-road Route; refer *std drg DS13-11*	**Refer *std drg DS13-08*** C: As per above except bicycle lane may continue through roundabout in certain circumstances P: As per above
	ST: **arterial road** VU: traffic volumes generally greater than 10,000vpd, controlled access NL: two lanes	Connectivity between town centres and highways, experienced users only	**Refer *std drg DS13-10*** C: Provide off-road shared path, ramps and bicycle lane termination as shown on *std drg DS13-05* P: Path width to allow for shared provision with faster-moving cyclists from on-road
		Identified Main On-road Route; refer *std drg DS13-11*	**Refer *std drg DS13-10*** C: As per above except bicycle lane may continue through roundabout in certain circumstances P: As per above
	ST: **rural road** VU: low traffic volumes NL: single lane	Touring and training circuits	**Refer *std drg DS13-08*** C: No provision; marked shoulders to be terminated as shown on *std drg DS13-05* P: Provision only where warranted

In the ACT, treatments that carry bicycle lanes through multi-lane roundabouts are not permitted on arterial roads with approach speed environments of 70 km/h and above. At these roundabouts, links to off-road paths and crossing points designed to cater for the likely user group should be provided. Cyclists should be encouraged, but not forced to use the off-road links and entry to such facilities should be designed so that an experienced cyclist has the choice to become a vehicular cyclist through the roundabout. This can be achieved by installing a high-speed off-road connection ramp as illustrated on standard drawing DS13-05 and not narrowing the pavement at the roundabout approach. This provision will allow the cyclist to continue through the roundabout without having to merge into the traffic lane.

To improve the safety of a vehicular cyclist choosing to travel through a multi-lane roundabout, the left lane should include additional width to act as a widened kerbside lane. Where bicycle lanes are provided through a roundabout, use of DuraTherm™ or an equivalent hard-wearing treatment should be considered at vehicle crossing points. In the retrofitting of cycling facilities to or the design of new roundabouts in approach speed environments of 70km/h and above, the following alternatives should be considered at an early stage to minimise safety risks to pedestrians and cyclists presented by this type of intersection. This is especially the case if the roundabout has or is proposed to have more than one circulating lane and is part of the Main Routes Network. These considerations must be balanced against other requirements that may be present at the location which may dictate preference for a roundabout.

- Implementation of other measures that may reduce cycle safety risks such as reducing the number of approach or circulating lanes, or decreasing the approach and departure speeds through revised geometry or other modifications that may lower the approach speed environment.
- Conversion of the intersection from a roundabout to a standard signalised intersection.
- Reduction of the speed limit at the intersection – this would normally require implementation of other measures to reduce the speed environment and be coordinated with the speed limits along the length of the road.

6.4.7 TERMINATION OF BICYCLE LANES AND MARKED SHOULDERS

Wherever a bicycle lane or marked shoulder ends, the edge line defining the facility should not run into the kerb or pavement edge. Instead the bicycle lane or marked shoulder should be terminated at full width or, if this is not possible, a minimum width of 1.0m for a marked shoulder or 1.2m (60km/h) to 1.5m (70km/h and

above) for a bicycle lane will allow cyclists to merge into the adjacent traffic lane. This provision applies where required on approaches to intersections as well as to mid-block terminations. Details of the termination treatment and where combined with a ramp to an off-road path are provided on standard drawing DS13-05.

6.5 ON-ROAD CYCLE FACILITIES RETROFIT ON ARTERIAL ROADS

6.5.1 GENERAL

When designing the retrofit of on-road cycle facilities on to arterial roads the following should be carefully considered:

- Provision of bicycle lanes through adjustment of linemarking to reallocate road space (refer Section 6.5.2)
- Reduction in speed limit to allow the provision of a bicycle lane and traffic lanes of acceptable lane widths within the available road width
- Provision of marked shoulders where the existing road width will not allow provision of a bicycle lane and excessive cost prevents pavement widening (refer Section 6.5.3)
- Parking arrangements along the route; for marking of bicycle lanes adjacent to parking refer NSW Bicycle Guidelines Section 5.1. Also consider use of green treatment where warranted (refer Section 6.6)
- Intersection treatments including advanced stop boxes and detector loops at signalised intersections (refer Section 6.5.4)
- Removal of redundant pavement markings and RRPMs (refer Section 6.5.5)
- Adequacy of existing lighting; possible lighting improvements that may be necessary both mid-block and at intersections

6.5.2 SELECTION OF ACCEPTABLE LANE WIDTHS

In provision of bicycle lanes on arterial roads, careful consideration is to be given to the choice of cycle and traffic lane widths.

Table 6.4 provides guidance in achieving a suitable combination of lane widths that may provide a perception of balance in the amenity of both motorist and cyclist in the division of the available road pavement.
Before using the minimum widths in Table 6.4, careful assessment of aspects of the road that may adversely impact traffic lane width reduction is to be undertaken. Aspects to be considered include:

- Road geometry - sight lines through any curves
- Speed environment
- Surface roughness
- Vehicle mix including heavy vehicle and bus usage
- For right hand side lanes
  - Gutter width
  - Drainage sump inlet intrusions
  - Sight distance

Table 6.4 Bicycle Lane Widths for Retrofitted Facility on Arterial Roads

Speed Environment	Bicycle lane width	Traffic lane widths (Retrofit only)
60 km/h	desirable 1.5m minimum 1.2m (marked shoulder minimum width 1.0m refer Section 6.5.3)	Left hand traffic lane where volume of heavy vehicles / buses is high - desirable 3.5m - minimum 3.3m Other lanes - desirable 3.3m - minimum 3.0m Left turn lanes - low traffic volume (< 3,000 turning vpd), bicycle lane may be incorporated into turn lane; - high traffic volume(> 3,000 turning vpd), minimum width 3.0m

80km/h	desirable 2.0m minimum 1.8m (marked shoulder minimum width 1.0m refer Section 6.5.3)	Left hand traffic lane where volume of heavy vehicles / buses is high - desirable 3.5m - minimum 3.3m Other lanes - desirable 3.5m - minimum 3.3m (3.2m for 8.3m c'way width) Left turn lanes: - low traffic volume (< 3,000 turning vpd), bicycle lane may be incorporated into turn lane; - high traffic volume(> 3,000 turning vpd), minimum width 3.0m

The following rules are also to be applied when using Table 6.4:

- Minimum bicycle lane widths are to be used as a last resort; traffic lanes are to be reduced to minimum widths prior to bicycle lane width reduction.
- For roads with a speed environment of 60km/h, traffic lane widths should be reduced to a minimum prior to bicycle lane width reduction from 1.5m. Where the bicycle lane will be less than 1.5m wide the following should occur:
    - Any pavement available after reduction of traffic lanes to minimum width should be utilised in the bicycle lane. In this instance, design drawings should show fixed traffic lane widths from the right hand kerb and set out methodology noted clearly on the drawings.
    - Pavement smoothness in the bicycle lane is to be to a high standard, and the full width of bicycle lane pavement should be made useable.
    - To minimise the risk of unacceptable pavement lipping at the gutter tray interface, the Practitioner should consider overlay of the gutter tray in these instances, with appropriate treatments at stormwater sumps.
- Narrower bicycle lanes than those shown may be considered for short distances or "pinch points" (maximum 50m) with appropriate signage. This is where the cost of providing the minimum bicycle lane width is prohibitive (eg. a narrow bridge) and the loss of amenity may be balanced against the provision of a continuous facility.
- Minimum traffic lane widths may be reduced to an absolute minimum of 3.2m where kerb widening may be avoided and road geometry and surface roughness are considered acceptable.
- For right hand lanes, when the use of minimum traffic lane width is proposed, careful consideration should be given to gutter width, road geometry, sight distance, drainage sump inlet intrusions and surface roughness. Improvements are to be made where necessary before reducing the lane to minimum width.
- For further guidance on traffic lane widths also refer to GRD Part 3.
-

6.5.3 MARKED SHOULDERS

Where a bicycle lane to meet minimum standards cannot be installed within the available pavement width, and road widening is not feasible, consideration is to be given to the provision of a marked shoulder. A marked shoulder shall only be installed if it can be a minimum width of 1.0 metre, including any gutter tray.

A marked shoulder is preferred over a widened kerb-side lane on arterial roads and is to be provided on Main On-Road Routes. On Main On-Road Routes a marked shoulder will provide more defined continuity of the facility, albeit to a lower standard, as an interim measure until road widening can be completed in the long term.

Where a bicycle lane leads into a marked shoulder, a "bicycle lane end" sign is to be installed at the commencement of the marked shoulder.

To allow loose sealing aggregate (stone) to be removed by traffic action prior to marking, the marked shoulder may be installed several months after resealing has occurred.

6.5.4 RETROFIT AT INTERSECTIONS

Minimum requirements may be applied when retrofitting an on-road cycling facility at intersections. Continuity of any facility is to be maintained across intersections wherever possible, and this may also apply to marked shoulders. Continuity of bicycle lanes on Main On-Road Routes and maintenance of the cyclists' right of way at intersections is to be considered a high priority, and is to be implemented whenever possible. In the context of signalised intersections this does not mean continuation of line marking through the intersection, but rather that continuity of facility to be provided on each side of the intersection.

Where on-road cycle facilities are to be provided through an existing signalised intersection the position of existing detector loops is to be established. These may require reinstallation to function depending on any proposed lateral shift of lanes required for installation of on-road cycling facilities. The position of the detector loop should be marked after any resurfacing that obscures its position so that cyclists and vehicles can know where to position to trigger a phase change.

Use of head start and expanded storage boxes are to be considered for retrofit when upgrading signalised intersections. Retrofit of expanded storage boxes should always be considered where there is a signal controlled left turn lane, coupled with a high volume of left turning or through buses and heavy vehicles (refer Section 6.4).

6.5.5 REMOVAL OF REDUNDANT LINEMARKING AND RRPMS

When linemarking the reallocated road pavement, the treatment of areas of pavement that have had raised pavement markers and linemarking removed is to be carefully executed in order to remove any risk of confusion and discomfort to motorists.

The pavement is to be left smooth and with a surface texture similar to the existing pavement following the removal of such devices.

Care is to be taken to ensure all RRPMs are removed from within the bicycle lane or marked shoulder area as they can cause a danger to cyclists.

6.6 COLOURED PAVEMENT TREATMENT

6.6.1 GENERAL

Coloured pavement treatment should be considered for use on bicycle lanes at potential conflict points between cyclists and vehicles. The colour green has been adopted nationally and internationally in many countries including New Zealand, for use to mark pavement defining cycle facilities. In the ACT this colour is defined as G15 Emerald Green or G16 Traffic Green; alternatively G23 Shamrock Green may be used with consent from the Road Authority. Use of the treatment should be consistent with NSW Bicycle Guidelines Section 8.1.3; however, it should be noted that all paths are shared paths in the ACT and use of coloured pavement treatment to mark off-road paths could be considered solely on designated cycle only paths.

6.6.2 WARRANT FOR USE OF COLOURED PAVEMENT TREATMENT

Coloured pavement treatment should be installed only after careful consideration, with due regard to the high cost of installation and maintenance as well as the risk that it may lose effectiveness as a warning device if over-utilised. Approval by the Road Authority is required prior to installation of coloured pavement treatment at any location.

There are a number of locations where coloured pavement treatment should be considered. These include drop-off parking locations, left turn slip lanes, exit ramps, storage boxes and on the approaches to and, in some instances, on the circulating carriageway of roundabouts. For use of coloured pavement treatment at roundabouts, refer to Section 6.4.6 and standard drawings DS13-09 and 10. For storage boxes, refer to NSW Bicycle Guidelines Section 7.3.4.

For drop-off parking, left turn slip lane or exit ramp locations, a warrant system has been developed to assist Practitioners in objectively identifying locations where coloured pavement treatment should be installed. The weightings and ratings applying to these locations for each criterion are shown in Table 6.5. To calculate a score for a location, multiply the weighting by the rating assessed for each applicable criterion and sum

together. For drop-off parking locations, add together the products of criterion 1-4; for left turn slip /exit lanes, add together the products of criterion 1- 3 and 5.

A score of 400–420 is an objective indicator that coloured pavement treatment may be warranted at the location.

Table 6.5 Warrant System for Coloured Pavement Systems

No.	Criteria	Weight		Rating		Rating		Rating
	Common Criteria							
1	Speed Environment	**10**	*80 km/h*	*10*	*70 km/h*	*8*	*60 km/h*	*6*
2	Visibility (Sight distance from vehicle travelling in left lane)	**10**	*Less than 60 m*	*8*	*60 m to 100 m*	*6*	*More than 100 m*	*4*
3	Traffic volume							
a	Vehicular traffic in the left traffic lane	**5**	*3,000 vpd or more*	*10*	*Between 3,000 and 1,500 vpd*	*6*	*Less than 1,500 vpd*	*2*
b	Overall through vehicular traffic in all traffic lanes	**5**	*10,000 vpd or more*	*10*	*Between 10,000 and 5,000 vpd*	*6*	*Less than 5,000 vpd*	*2*
c	Cyclist Traffic (future expected)	**5**	*300 cycles per day or more*	*10*	*Between 300 and 100 cycles per day*	*6*	*Less than 100 cycles per day*	*2*
	AND ***Drop Off Parking***							
4	Adjacent drop-off parking areas	**10**	*High use drop off area with more than 5 spaces*	*20*	*High use drop off with less than 5 spaces*	*17*	*Medium use drop off with less than 5 spaces*	*15*
	OR ***Left turn lane / exit lane***							
5a	Vehicular traffic turning left turning left	**10**	*3,000 vpd or more*	*10*	*Between 3,000 and 1,500 vpd*	*8*	*Less than 1,500 vpd*	*4*
5b	Left turn slip lane exposure length	**10**	*50m or more*	*15*	*20m to 50m*	*8*	*10m to 20m*	*5*

Typical arrangements for the use of coloured pavement treatments for drop-off zones, left turn slip lanes and entry and exit ramps are shown on standard drawings DS13-21 and 22. Where coloured pavement treatment is installed at an exit ramp crossing, a rest rail arrangement must also be installed.

Exposure length is defined as the length of a bicycle lane where the cyclist can be regarded as having a high risk of conflict with vehicular traffic. Coloured pavement treatment should not generally be considered if exposure length is less than 10m for areas such as left turn slip lanes and adjacent drop-off parking areas.

On roads with speed environments greater than 60 km/h, continuation of bicycle lanes across higher speed entry or exit ramps should not be considered. Continuation of bicycle lanes across exit ramps can be considered only in 80km/h speed environments where there are two traffic lanes in the direction of travel to allow vehicles to change lanes if a vehicle slows to give way to a cyclist. Refer to standard drawing DS13-04 for examples of exit ramp crossings.

Refer to NSW Bicycle Guidelines Section 7.5 for entry ramp crossings and entry and exit ramp signage arrangements.

Holding rail turn-outs should be provided where appropriate (for details refer to standard drawing DS13-04). Holding rails and turn-outs should generally be provided on exit ramps on roads in the urban area and may be omitted in rural areas

6.7 PATH GRADIENT

For footpaths, the *Key Reference* documents do not give clear guidance on requirements for maximum gradient. Paths associated with building developments should comply with AS1428 Design for Access and Mobility. It is not always possible to apply this standard to all footpaths, e.g. urban paths in verges with steep

slopes. Footpaths may be provided for connectivity reasons in such circumstances but Practitioners should identify alternative routes for footpaths to optimise compliance for disabled users. Table 6.6 identifies requirements for maximum gradients of pedestrian pathway routes.

Table 6.6 Footpath Gradients

Gradient	Type	Conditions	Compliance with Access & Mobility
< 3.5%	Footpath	NIL	Yes
3.5% to 5%	Footpath	1.2m rests at 18m	Yes
5% to 12.5%	Footpath	NIL	No
12.5% to 37% (1:2.7)	Ramp*	NIL	No
> 37%	Stairs	NIL	No

* *Ramps are not suitable in urban environments.*

Ramps and stairs shall comply with the requirements of AS1657 Fixed platforms, walkways, stairways and ladders.

Careful consideration should be given to treatment at the approach to crossings on steeper paths. Wherever possible, paths should be curved before a crossing to encourage cyclists to slow down and provide a strong visual marker that there is a change in conditions ahead. Appropriate landscape treatments that do not interfere with sight lines should then be installed to prevent shortcutting.

Landscape treatments should also be installed to prevent shortcutting where paths in public open space are curved as a means to reduce gradients. Use of rails, bollards or other devices to prevent shortcutting that may present a hazard to cyclists is not permitted.

6.8 PATH CROSS SECTION

The *Key Reference* documents provide the design requirements for the cross section details of various path types. Notwithstanding these requirements, paths shall comply with the following:

- For Intermediate and Trunk paths, a 500mm wide "shoulder" where provided shall have the same crossfall as the path before transitioning to the batter slope.
- Root barriers should be installed on all pathways in close proximity to trees.

The cross section details are in standard drawing DS13-01.

6.9 ROOT BARRIERS

All paths that may be at risk of damage from tree root damage are to have root barriers installed (refer Trunk Road Infrastructure Technical Specification No.09 - Landscape).

6.10 PATHS AND FLOODWAYS

The protection of pedestrians and cyclists from flood events is a personal safety issue and practitioners should consider crossings of floodways on a case by case basis.

In general, Trunk paths should, as a minimum be located above the flood level of a storm event with a 2 year Average Recurrence Interval (ARI). Paths which are parallel to floodways should be as high as possible.

For retrofit of paths, protection to less than a 2 year ARI flood event may be appropriate with careful consideration of the following:

- Need for the path.
- Economic feasibility of providing 2 year ARI flood event protection.
- Suitable alternatives for when the path is unserviceable.
- Length of time path is unserviceable in the 2 year ARI flood event.
- Risk of use in the 2 year ARI flood event; danger of depth and velocity of flow.

Relaxation of the 2 year ARI flood protection will only be allowed with the endorsement of the Road Authority.

At-grade crossings of floodways may be provided for footpaths and Intermediate paths under the following conditions:

- The alignment of paths is to be carefully examined at the planning stage. The number of floodway crossings should be optimised by utilising any nearby existing or proposed alternative high level crossings. This is to avoid, as far as possible, construction of crossings solely for paths.
- In situations when crossings for paths have to be provided across floodways:
- At-grade crossings will be provided for Intermediate Paths and Minor Paths, and;
- Suitable structures that satisfy appropriate performance criteria for Trunk Paths shall be provided.

Where there is a definite desire line of travel that crosses a floodway for any type of path and a good quality high level crossing exists nearby (to which the cycleway or footpath would be connected), then the desire line can also be satisfied by an at-grade crossing.

6.11 ROAD CROSSINGS

The treatment of path crossings at roads and intersections shall comply with the requirements of the *Key Reference* documents. This includes the provision of pedestrian refuges, pram ramps and pram crossings. Refer to standard drawing DS3-02 for details of pram crossings and pram ramps.

Pram crossings are required at all points where any class of path meets any type of kerb (except flush).
Practitioners should note the complex safety and operational issues that arise where pedestrian and cycling routes cross certain types of intersections. VicRoads Cycle Note No.16 provides good guidance on the selection of off-road path crossing type.

Some key factors to be considered in the development of a suitable crossing design include:

- *All path crossings*. Ensure sight distances are adequate for all road and path users and that safe and convenient crossing locations are provided.
- *Pedestrian / cycle refuges*. Refuges may be required where traffic volumes are high (eg. Collector Streets). Refuges shall be 2.0m minimum width to cater for a bicycle (*generally* 1.75m long). On paths that have higher numbers of users, it may be necessary to increase the width of the island to provide greater storage capacity to allow for bicycles with trailers or tandem bicycles.
  The need for a refuge should be determined on a case by case basis addressing issues such as sight distances, vehicle speeds, proximity to primary schools etc. that will determine if a two stage crossing is warranted.
  Crossings at roundabouts should provide pedestrian refuge within the splitter islands and the crossing should be located 6m behind the hold line. This latter condition may not be possible in minor or mini roundabouts.
- *Pedestrian crossings*. *)* the warrants for marked foot and pedestrian *crossings are:*
- Practitioners should note the regulations in the *Australian Road Rules* with respect to use of marked foot and pedestrian crossings including the requirement for cyclists to dismount at these crossings.
- *Path priority treatments*. Use of marked foot and pedestrian crossings is not desirable on Main Community Routes with high cyclist usage, as a cyclist is required by law to dismount to cross. Use of a path priority crossing treatment such as "Give Way" or "Stop" sign crossings, which allow cyclists to ride across, should be considered in these instances. This crossing type should be considered on Main Community Routes when traffic volumes are low and peak path usage is greater than 100 users per hour. The crossing should be on a hump, and may be used in conjunction with other calming devices where appropriate, to slow traffic down in advance of the crossing. Use may also be appropriate when the crossing is part of a Local Area Traffic Management scheme.
- *Signalised crossings* may be considered where peak traffic volumes on the road exceed 1,000 vehicles per hour and peak path usage is greater than 100 users per hour. Bicycle crossing lights are to be provided on Main Community Routes. Signalised crossings should only be installed in appropriate locations and their function can be co-ordinated with other sets of traffic signals.

Rest rails at holding points are to be provided at crossings on Main Community Routes, Trunk paths, exit and entry ramp crossings and paths provided at roundabouts for diversion of on-road cyclists. Rest rails should be provided at any place where right of way is removed from a cyclist on Main Community Routes, including major driveways and local street crossings. To avoid confusion to both motorists and cyclists, rest rails should

not be provided where a cyclist has priority. Refer to standard drawing DS13-04 for details of types and appropriate positioning of rest rails.

6.12 USE OF TACTILE GROUND SURFACE INDICATORS

6.12.1 ACCESSIBLE PEDESTRIAN NETWORKS

Tactile Ground Surface Indicators (TGSI) are to be provided on Accessible Pedestrian Networks (APNs) generally in town, group and local centres for people with vision impairment.

The objective of APNs is to provide logical and clear accessible walkway routes around prescribed areas to enable access for blind or visually impaired people to facilities in a safe and easy manner. This involves definition of continuous, clear paths of travel with access to all features such as designated car parking spaces, taxi ranks, set down areas, bus stops, building entrances and fixtures.

The mapping of Accessible Pedestrian Networks for the various town, group and local centres will be completed over time. An APN has been completed for Civic and details of this network and how to establish an APN is provided in the Civic Accessibility Study - Volume 3, Access Guidelines.

6.12.2 INDICATOR TYPES

Strict design requirements are essential to ensure the consistency needed for correct interpretation of the warning that TGSI provide to people with visually impairment. The warning system comprises two types of TGSI:

- *Warning indicators* are a series of raised dots, which warn of an impending hazard. They are also used to indicate a "Change of direction".
- *Directional indicators* are a series of raised lines, which provide directional orientation and are placed in a continuous run from the Accessible Pedestrian Network to the feature to which access is required.

Both *warning* and *directional* indicators must comply with AS 1428.4. In order to be serviceable in Canberra, with high UV and frost conditions, only ceramic, precast units or UV stable plastics are acceptable. 30% luminance contrast to background is required in all lighting and weather conditions.

Warning indicators are to be located in accordance with AS 1428.4.

Warning indicators are required on the Accessible Pedestrian Network as follows:

- All road crossings including pram crossings and pram ramps.
- Vehicular crossings with poor sight lines.
- Any overhead obstructions lower than 2m without a kerb or another barrier at least 150mm high.
- Where a sloping face intrudes into the clear path of travel at a point lower than 2m, 300mm out from base (Note: Such obstacles shall also meet the 30% luminance criteria).
- Top and bottom of stairs and ramps to a gradient of 1 in 20.
- At mid landing of stairs and ramps where handrail is not continuous the *warning* indicators need to be only 300mm in depth across the full width of the trafficable surface.
- At the end of or at stopping point of directional indicators or at change of direction of directional indicators.

Warning indicators are to be installed at bus stops in accordance with standard drawing DS13-03.

Directional indicators are required on the Accessible Pedestrian Network as follows:

- Midblock crossings.
- At T intersections.
- To bus timetables.
- To major signage (beacons).

- Across large open spaces where no other route or tactile cueing is available and where *directional* indicators are considered to be beneficial (eg to a point of entry to a significant public facility. Refer AS 1428.4 Clauses 2.2.4.1 and B3.3.

Examples of applications and details of installation requirements for *warning* and *directional* indicators may be referenced in Civic Accessibility Study - Volume 3, Access Guidelines and AS1428.4. Where there is conflict between the two reference documents AS1428.4 is to take precedence.

6.13 PROVISIONS AT STRUCTURES

The reference documents provide details of requirements at structures such as underpasses, bridges, culverts, etc. Practitioners should consider the most cost effective measures to provide for safe, uninterrupted movement of pedestrians and cyclists at proposed and existing structures. In particular, Practitioners should note requirements for barriers and handrails, ramp gradients, sight distances, batters and clearances.

Refer to TRIS 07 Bridges for specific requirements at bridges. The following are the minimum provisions:

- Where on-road cycling facilities are provided such as a bicycle lane, wide kerbside lane or marked shoulder, this provision should extend across the bridge structure. If the bridge is on an arterial road, provision for a bicycle lane of appropriate width for the speed environment is to be allowed.
- Where a Trunk path is provided adjacent to the road and is required to be continuous along the road route, the path is to be continued across the bridge. The minimum clear widths are:
  - Trunk Path 3.0m, bridge path 4.0m or 3.6m to allow 150mm pedal clearance to balustrades from smooth rail.
  - Trunk Path 2.5m, if on a Main Community Route bridge path should be 4.0m, otherwise 3.4m or 3.0m is required to allow 150mm pedal clearance to balustrades from smooth rail.
  - Footpath 1.2m, bridge path 1.8m.

  The above widths meet the requirements of clearances to guard rails and balustrades. It is generally not acceptable to divert a Trunk path from the bridge to dip through an underpass or low level crossing.
- Where a path is not provided, say on the median side of an arterial road, provide a safety zone 1.2m wide (kerb to guardrail) across the bridge.

Refer to Trunk Road Infrastructure Technical Specification No.12 - Street Lighting on requirements to ensure paths near and within structures are adequately illuminated for public safety and community surveillance.

6.14 PROVISIONS AT TRAFFIC CALMING DEVICES

Local area traffic management treatments such as chicanes, raised platforms and mini roundabouts should be designed such that cyclists on the road are not forced or squeezed into unsafe situations. Either provide a separate protected route for cyclists or allow sufficient width for a car and cyclist to pass the device without hazard. Examples of treatments are indicated in GTM Part 8 and AS1742 Part 13.

6.15 END OF JOURNEY FACILITIES

Consideration must be given to design of adequate facilities at common destinations of cyclists and pedestrians so as to encourage bicycle and pedestrian usage.
Such facilities could include:

- Connectivity through provision of ramps and crossings to enable safe riding / walking to reach destination points within the destination node.
- Bicycle racks / parking areas.
- Bicycle lockers / storage.
- Seats.
- Shelter.

The *Key Reference* documents provide guidance on bicycle racks, storage lockers and other end of journey facilities. Careful consideration shall be given to the appropriate placement of these facilities with regard to public transport connectivity, security, passive surveillance and proximity to destination points.

7 SIGNAGE

7.1 GENERAL

Signage for pedestrians and cyclists is to be sited so as to be visible and legible with particular regard to the eye height and sight lines of these users. Signage should be placed as low as possible to permit good visibility by pedestrians and cyclists. Wherever possible, signage should be placed to maximise visibility at night through the use of existing lighting.

Signage is to be placed to not be ambiguous to road users and minimise any risk of confusion with road signage. Directional signage for off-road paths is not to be co-located with road directional signage.

Unless approved by the Road Authority directional signage for pedestrians and cyclists is to be restricted to the Main Routes network as illustrated on standard drawing DS13-11.

7.2 MAIN ROUTES SIGNAGE

7.2.1 ROYAL BLUE ON WHITE CONVENTION

To enable cyclists and pedestrians to easily identify Main Community routes, signage is to be in royal blue on white instead of black on white. This applies to the (main) shared path sign which will allow for use as a reassurance sign, and differentiate Main Community Routes from other Trunk paths.

Connector Routes are to be signed in royal blue on white whereas bicycle lanes will be signed in black on white. This may be used as a guide by the cyclist to differentiate the level of skill and experience that may be required to feel comfortable using a particular cycling facility. Accordingly, a royal blue on white cycle only sign represents a facility such as a Connector Route applicable more for recreational and family cyclists, whereas black on white cycle only sign represents bicycle lanes generally on arterial roads.

7.2.2 DIRECTIONAL SIGNAGE PRINCIPLES

The principles for design of directional signage are based on a hierarchy of routes and destinations. However, the development of the route network and evolution of planning over a number of years in the ACT has resulted in a variety of network characteristics that preclude the formulation of rigid signing rules. The application of a flexible and rational approach, within the established framework, is, therefore, an important part of guide-sign planning and design.

It is also presumed that a signage system cannot cater for the entire length of most journeys and that some additional form of aid such as a cycling and walking map, street directory, or verbal/written instructions remain a necessity for most travellers.

Destinations for which guide signs are provided include urban destinations, services and tourist attractions. Destinations for signage are divided into two categories:

- Primary Destinations, and
- Secondary Destinations.

7.2.3 PRIMARY DESTINATIONS

There are seven primary destinations nominated for the Canberra region that shall be signed as follows:

- Belconnen
- City
- Gungahlin
- Queanbeyan
- Tuggeranong
- Weston Creek
- Woden

The extent of influence for each primary destination is shown on standard drawings DS13-31 to 37 with direction arrows at key decision points (refer Section 7.3.2) to indicate the route to be signed.

7.2.4 CITY AND TOWN CENTRES

Belconnen, Gungahlin, Tuggeranong and Woden are defined as Town Centres as they are areas subject to Commercial A and B land use policies in the Territory Plan. Within two kilometres of the centre of the four listed Town Centres the destinations shall be signed as "Town Centre". The two kilometre radius is shown on standard drawings DS13-31, DS13-33, DS13-35 and DS13-37.

Civic is also defined as a Town Centre. However it is always to be signed as City.

7.2.5 SECONDARY DESTINATIONS

Secondary destinations have a lower extent of influence than primary destinations and are generally signed within close proximity of the destination.

The following represents details of how secondary destinations are to be signed:

- Suburban Shops

  Suburban Shops are signed from Main Community routes only with local area signage in accordance with Section 7.3.2.
- Group Centres

  The group centres are to be signed as: "Calwell Centre", "Charnwood Shops", "Chisholm Centre", "Cooleman Court", "Curtin Shops", "Dickson Shops", "Erindale Centre", "Hawker Shops", "Jamison Centre", "Kaleen Plaza", "Kambah Village", "Kingston Shops", "Kippax Centre", "Lanyon Marketplace", "Manuka Shops", "Southlands" and "Wanniassa Shops".
- Industrial Areas

  The main industrial areas are to be signed as: "Fyshwick" and "Mitchell". Hume and Belconnen are minor industrial areas and the road signage is considered sufficient.
- Employment Areas

  The employment areas are to be signed as: "Bruce", "Russell", "Airport" and "Parliamentary Zone". Symonston, Symonston (North) and Symonston (West) are not proposed to be signed.
- Tertiary Educational Institutions

  The tertiary educational institutions are to be signed as: Australian National University – "ANU"; University of Canberra – "UC"; and Canberra Institute of Technology – "CIT"; The Australian Defence Force Academy, Australian Catholic University, National Theological Centre and Australian International Hotel School are not proposed to be signed.

  Other destinations not listed above may be signed with the approval of the Road Authority.

7.3 MAIN COMMUNITY ROUTES SIGNAGE

7.3.1 GENERAL

A higher standard of signage is to be provided on Main Community Routes. Typical layouts for signage placement are shown on standard drawing DS13-13.

7.3.2 MAIN COMMUNITY ROUTE SIGNS

Main Community Routes are to be marked with a main shared path sign that is royal blue on white, instead of the Australian Standard shared path sign that is black on white (Sign DS13-12/2). Trunk paths are to be marked with standard black on white shared path signs (Sign R8-2A). The DS13-12/2 sign is also to be used as a re-assurance sign on Main Community Routes, and is to be installed in conjunction with all key decision point signage (refer below) and at other decision points. A decision point is defined as any point along a Main Community Route where the user may require directional reassurance to continue on the signed route. This includes junctions with paths that may appear to be the same hierarchy as the Main Community Route.

A direction arrow sign DS13-12/3 is to be installed with the DS13-12/2 sign at other decision points such that directional signage (including key decision point and re-assurance signage) should be at a maximum spacing of not more than 1 kilometre.

Details of signs DS13-12/2 and 3 are shown on standard drawing DS13-12.

7.3.3 KEY DECISION POINT SIGNAGE

A key decision point is defined as the intersection of two or more Main Community Routes. All key decision points shall have a signed destination(s) for each route leg and shall generally include a primary destination for each route.

Key decision point signage shall include a Route Name (refer Section 7.3.6) and a shared sign path (DS13-12/2) as well as the direction sign. The direction sign shall include the destination name, a direction arrow and distance to the geographic centre to the nearest kilometre. The defined geographic centre for each primary destination is shown on standard drawings DS13-31 to 37. Refer to standard drawing DS13-12 for sign details and standard drawing DS13-13 for a typical signage layout.

The Main Community Route network has evolved such that more than one Main Community Route may lead to the same primary destination from a key decision point. The Practitioner shall refer to standard drawings DS13-31 to 37 to establish which legs at the key decision point have nominated primary destinations. Where a primary destination is not indicated on standard drawings DS13-31 to 37 a secondary destination shall be signed.

The secondary destination to be included on the key decision point signage will typically be one of the nominated destinations listed in Section 7.2.5, or if not applicable, the suburb adjacent to where the next key decision point is located. If the route has no further key decision points because it ends without passing through another key decision point, the suburb that the Main Community route ends in shall be signed.

Once a secondary destination is signed that destination shall be continuously signed at all key decision points along the route until that destination is reached. This may require more than one destination to be shown on a leg.

Where a Main Community Route meets a path that is not a Main Community Route and there may be some ambiguity as to the direction of the Main Community Route, a main route shared path sign (DS13-12/2) and directional arrow (DS13-12/3) shall be erected for directional re-assurance in accordance with Section 7.3.2.

7.3.4 START SIGNS

A start sign is to be provided where a Main Community Route exits from the City and Town Centres defined in Section 7.2.4. The sign is intended to advise users of the distance to the primary destinations that are on or lead from the signed Main Community Route. The sign shall be located based on site observations and shall be discussed with the Road Authority prior to detailed design. Details of the start sign are shown on standard drawing DS13-12.

7.3.5 LOCAL AREA SIGNAGE

Local area destination signage may be provided at the intersection of a Main Community Route with a path of lower significance that provides the shortest link and leads directly to a secondary destination as defined in Section 7.2.5. The sign is to include the local area destination name and distance to the nearest kilometre, or if under 1 kilometre to the nearest 0.1 kilometre. Refer to standard drawing DS13-12 for sign details.

Local area signage is to be placed on a Main Community Route only once for each direction of travel for each secondary destination. Depending on the path network leading from the Main Community Route these signs may be positioned at a single path junction (back to back) or at two separate path junctions where shorter routes exist from each approach direction. The sign should be placed on a path where a direct route to the destination exists, and additional direction signage is not required. Refer to standard drawing DS13-14 for a typical signage layout.

Other factors with regard to the anticipated user groups should also be considered in the choice of path to be marked with a local area destination sign. These factors include:

- Quality of path
- Complexity of route
- Users with regard to disabled access
- Pram ramp provisions

7.3.6 ROUTE NAME SIGNS

Route name signs are to be installed in conjunction with Key decision point signage (refer standard drawing DS13-12 for details).

Not all routes may be named and in the case of an unnamed route, signs should be placed on the pole support such that the route name sign may be installed in the future. Route names may be obtained from the Road Authority.

7.3.7 STREET NAME SIGNS

Street name signs should be provided at street crossings on Main Community Routes if not visible from the crossing point. This is to allow the user to locate themselves on their journey. This requirement may be relaxed if street signs are visible within 50 metres of the crossing.

The street sign should be installed parallel with the street crossed, in a location clearly visible and as close as possible to the path crossing. An example street crossing is included on standard drawing DS13-13. The sign should be installed on existing poles such as light poles or share with other signage wherever possible.

7.3.8 ON-ROAD CYCLING CONNECTION DIRECTION SIGN

At connection points from Main Community Routes to bicycle lanes an on-road cycling connection direction sign is to be installed. This sign is detailed on standard drawing DS13-12 and a typical signage layout is provided on standard drawing DS13-14.

7.4 CONNECTOR ROUTES SIGNAGE

7.4.1 GENERAL

Connector Routes are to have continuous directional signage to allow a cyclist to follow the route to its destination through required turns at road intersections and connecting off-road path links as necessary. A combination of Connector Route direction signs and re-assurance signs are to be provided to achieve this aim. Typical layouts for signage placement are shown on standard drawing DS13-13 and 14.

7.4.2 CONNECTOR ROUTE DIRECTION SIGN

Connector Route direction signs are to be placed at decision points along the route at a maximum spacing of not greater than 1 kilometre.

Connector Route direction signs are to show the primary destination name as listed in Section 7.2.3 and distance to the nearest kilometre, or if under 1 kilometre to the nearest 0.1 kilometre. Other destinations may be appropriate if they represent the end point of the route. Details of the Connector Route direction sign are shown on standard drawing DS13-12.

7.4.3 CONNECTOR ROUTE RE-ASSURANCE SIGN

The Connector Route reassurance sign (sign DS13/12-1) is to be installed at every decision point where a Connector Route direction sign is not installed. This includes clear direction on to and along any off-road linkages that may make up the Connector Route.

Details of sign DS13-12/1 are shown on standard drawing DS13-12.

7.4.4 CONNECTOR ALTERNATIVE ROUTE DIRECTION SIGN

The Connector alternative route direction signs are to be installed where a Connector Route intersects a Main On-Road Route or a Main Community Route.

Details of the Connector alternative route direction sign are shown on standard drawing DS13-12. A typical layout illustrating the proposed usage of this sign is shown on standard drawing DS13-14.

7.5 ON-ROAD CYCLING SIGNAGE

On road cycling signage is to be in accordance with GRD Part 3 and the other *Key Reference* documents. There are no special signage requirements for Main On-Road Routes except as defined in Section 4.4. Bicycle lane signs are generally to be a minimum B size and a minimum C size in 80km/h speed zones.

Where a bicycle lane passes by, over, under or parallels a Main Community Route and there is a connection path provided to enable passage of a cyclist to the off-road path, a main shared path sign (sign DS13/12-2) and a direction arrow (DS13/12-3) are to be installed to indicate the linkage between facilities.

7.6 BEHAVIOURAL SIGNAGE

The Share the Path sign (DS13/15-1) has been developed for use on Main Community Routes to encourage appropriate walking and cycling behaviour by path users. Refer to standard drawing DS13-15 for details of the sign.

The DS13/15-1 sign should be used in pairs facing path users approaching from each direction, generally at a spacing of 500m to 1km on Main Community Routes. Main inflow points onto a Main Community Route, such as paths at a main road junction, may require a split installation of the sign to address people moving in either direction on the Main Community Route from the inflow path(s). At other locations the signs may be installed on each side of a single pole. The sign may also be installed at specific locations to address reported behavioural issues. Wherever possible, the signs should be installed to minimise the number of new poles, either through use of existing light poles where opportunity allows or use of the back of other paired signs such as Road Ahead signs.

7.7 RURAL TRAINING CIRCUIT SIGNAGE

Where there are circuits or particular sections of road used on a regular basis by training and racing cyclists the installation of rural training circuit signage in accordance with VicRoads Cycle Note No. 6 is to be considered. The signage is only to be used with the consent of the Road Authority with consultation with the ACT Veteran and Canberra Cycling Clubs.

8 TERMINOLOGY

The Austroads Glossary of Terms is the source of definitions and meanings for the most commonly used terms in this document. The following terms apply specifically in ACT;

- ***Connector Route:*** *main cycle route that utilises local and minor collector streets and off-road path linkages to provide connections in the Main Community Path network where it may not be feasible to provide a trunk path.*
- ***Shared Use Path:*** *A path open to the public that is designated for, or has as one of its main functions, use by both cyclists and pedestrians, but which does not include a separated footpath or a footpath adjacent to a road.*

9 REFERENCES

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VicRoads 2005, *Cycle note no. 16: Safe road crossings for off-road paths*, VicRoads, Melbourne, VIC.

10 STANDARD DRAWINGS

The standard drawings relevant to Pedestrian and Cycle Facilities are as follows:

Title	Drawing Number
• Path Standard Details	DS13-01
• Vehicle Restriction Details	DS13-02
• Bus Stop Standard Details	DS13-03
• Cycle Rest Rail Details	DS13-04
• On to Off-Road Path Connection Details	DS13-05A
• Main Community Route Driveway Crossing	DS13-06
• Single lane roundabouts : 50km/h or less	DS13-07
• Single lane roundabouts : greater than 50km/h	DS13-08
• Two lane roundabouts : 60km/h	DS13-09
• Two lane roundabouts : 70km/h and above	DS13-10
• Main Routes Network (Proposed and Existing)	DS13-11
• Main Routes Guide Signs Standard Details	DS13-12
• Sign Location Layouts - 1 of 2	DS13-13
• Sign Location Layouts - 2 of 2	DS13-14
• Share the Path Sign	DS13-15
• Coloured Pavement Treatment	DS13-21
• Coloured Pavement Treatment at Exit Ramps	DS13-22
• Signage Extent of Influence - Belconnen	DS13-31
• Signage Extent of Influence - City	DS13-32
• Signage Extent of Influence - Gungahlin	DS13-33
• Signage Extent of Influence - Queanbeyan	DS13-34
• Signage Extent of Influence - Tuggeranong	DS13-35
• Signage Extent of Influence - Weston Creek	DS13-36
• Signage Extent of Influence - Woden	DS13-37