



ENGINEERING GUIDELINES

PART 1 - DESIGN 2026

**ROADS, WATER SUPPLY, SEWER, STORMWATER, & OPEN
SPACES**

DEVELOPMENT & GENERAL CONSTRUCTION

Table of Revisions

Revision	Date	Remarks
1.0 Approved	9/10/2026	

Document Control

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Role:	Manager Engineering & Assets
Team:	Infrastructure & Assets
Local Government Authority:	Hilltops Council
Version number:	1.0
Version date:	09/10/2026
Status:	APPROVED
File / document number:	HC.V1.0

Document Authorisation

Name	Signature	Date
Approved by: Acting Director Infrastructure	Jaime Dyhrberg	09/10/2026

Table of Contents

1	Introduction.....	1
1.1	Background	1
1.2	Consultation with Council.....	1
1.3	Prior to Plan Preparation.....	2
1.3.1	General.....	2
1.4	Engineering Drawings and Specifications	3
1.4.1	Submission of Engineering Drawings.....	3
1.4.2	Submission of Construction Specification	4
1.4.3	Approval of Engineering Drawings and Construction Specification	4
1.4.4	Commencement of Works.....	4
1.4.5	Developer's Responsibility.....	5
1.5	Inspection of Works	5
1.5.1	Inspection and Uninterrupted Access	5
1.5.2	Public Safety.....	5
1.5.3	Damage to Services.....	6
1.5.4	Traffic Control	6
1.5.5	Fire Fighting Provision	6
1.5.6	Work within Railway Property.....	6
1.5.7	Notification	6
1.6	Fees and Contributions.....	7
1.6.1	Subdivision/ Development Inspection Fees.....	7
1.6.2	Services/Facilities and Headworks Contributions	7
1.6.3	Testing of Works	8
1.7	Bonds and Guarantees for Performance.....	8
1.7.1	Deferred Works.....	8
1.8	Works-As-Executed	8
1.9	Handover of Completed Works	10
1.9.1	Notification of Completion	10
1.9.2	Maintenance of Works	10
1.9.3	Release from Maintenance Period	10
1.10	Survey and Setting-out Requirements	11
1.10.1	Centreline Marking.....	11
1.10.2	Datum and Co-ordinates	11
1.10.3	Bench Marks.....	11
1.10.4	Survey Control Marks	11

1.10.5	Lot Boundaries.....	11
2	Glossary of Terms.....	12
3	General Matters.....	19
3.1	General.....	19
3.2	Reference Documents	19
3.2.1	Local Environmental Plans.....	20
3.2.2	Development Control Plans	20
3.2.3	Contributions Plans.....	21
3.3	Conflicting Standards and Guidelines	21
3.4	Departure from the Specification.....	22
3.5	Council's Standard Drawings	22
3.6	Lapsing of Approvals and Certificates	22
3.7	Project Personnel	23
3.8	Limitations on Accredited Certifiers	23
3.9	Works Subject to Approvals by Other Authorities	24
3.10	Crown Roads.....	24
3.11	Classified Roads and Applicable Standards.....	25
3.12	Constructability, Health and Safety in Design.....	25
4	Safe System Approach	26
4.1	Road Safety Audits	26
4.2	Bushfire Prone Areas (BPA's).....	28
4.3	Design in Flood Affected Area	28
4.4	Format for Designs	29
5	Applications for Works Approval.....	30
5.1	General.....	30
5.2	Consultation with Council.....	30
5.3	Development Consent	31
5.4	Preparation of Engineering Design Submission to Council.....	31
5.5	Submission of Preliminary Engineering Plans to Council	31
5.6	Other Approval Applications Required by Council	31
5.7	Other Issues Relating to Development Consent.....	32
5.8	Application to Modify Works Approval	32
5.9	Works Undertaken by Council.....	32
6	Site Earthworks Design	34
6.1	General.....	34
6.2	Expansive and Reactive Soils	34

6.3	Urban Salinity	34
6.4	Minimisation of Soil Surplus	34
6.5	Site/Lot Regrading	35
6.6	Retaining Walls and Batters	37
6.7	Acoustic or Landscaped Mounds	38
6.8	Site Classification in Accordance with AS2870.....	38
6.9	Effects on Utility Services.....	38
7	Design Requirements for Roads Civil Works.....	39
7.1	General.....	39
7.2	Design Requirements for Roads	39
7.2.1	Road Carriageway and Verge Widths	39
7.2.2	Road Design Speed.....	46
7.2.3	Geometric Design	46
7.2.4	Intersection Design	48
7.2.5	Roundabout Design	50
7.2.6	Turning Facilities.....	51
7.2.7	Half Road Construction.....	52
7.2.8	Shoulder Construction	53
7.2.9	Upgrading Rural Public Roads	53
7.2.10	Extension of and Connections to Existing Roads	54
7.2.11	Local Area Traffic Management (LATM)	54
7.2.12	Traffic Facilities	54
7.2.13	Batters Outside Road Formation (Subdivision Lots and Reserves) ...	59
7.2.14	Retaining Walls for Road Formations.....	60
8	Design of Pavements.....	62
8.1	General.....	62
8.1.1	Preparation and Council Acceptance of Reports	62
8.1.2	Small Pavement Projects	62
8.1.3	Roads within Floodways	62
8.1.4	Pavements for Private Ownership.....	62
8.1.5	Pavement Design Life	63
8.2	Pavement Design Report.....	63
8.3	Design Traffic Loading	64
8.4	Evaluation of Subgrade.....	64
8.4.1	Determination of Design Subgrade CBR.....	64
8.4.2	Expansive (Reactive) Soils	65

8.5	Subsurface Drainage	65
8.6	Flexible Pavement Design	66
8.6.1	Wearing Surface – Bituminous Spray Sealing Design	66
8.7	Rigid Pavement Design	66
8.8	Asphalt Pavement Design	67
8.8.1	Sprayed Seal Under Asphalt Surfacing	67
8.8.2	Edge Drains for Asphalt Pavement Layers	67
8.9	Interlocking Segmental Block Pavement Design	67
8.10	Roundabout Pavement Design	68
8.10.1	Roundabout Full Depth Asphalt Pavement Design	68
8.10.2	Heavily Bound Pavements	68
8.10.3	Roundabout Rigid Pavement Design	68
8.11	Industrial and Commercial Area Road Pavement Design	68
8.12	Council Standard Pavement Design	69
8.13	Temporary Roadwork at Temporary Road Ends	69
8.14	Temporary Side Tracks and Deviations	69
8.15	Private Access, Paths and Battle-Axe Driveway	69
8.16	Car Park Pavements	70
8.17	Concrete Paths	70
8.18	Pavement Surfacing	71
8.18.1	Sealing of Unsealed Roads Near Occupied Homesteads/Shearing Sheds	71
8.19	Vehicle Crossings	72
8.20	Rural/Residential and Rural Driveways	72
8.20.1	Driveways for Unsealed Roads	72
8.20.2	Driveways from Sealed Roads	72
9	Design of Structures within Road Reserve	73
9.1	Retaining Wall Design Requirements	73
10	Design of Property Access, Car Parks, Paths and Cycleways	76
10.1	General	76
10.2	Vehicle Access to Properties	76
10.2.1	Earthworks and Maintenance	76
10.2.2	Urban Property Access	76
10.2.3	Residential Battle-axe Driveways	78
10.2.4	Multi-unit Residential, Commercial and Industrial Battle-axe Driveways	79
10.2.5	Rural Property Access	79

10.2.6	Rural Residential Battle-axe Driveways and Internal Driveways.....	81
10.2.7	All Weather Access in Private Property	82
10.2.8	Non-standard Vehicle Access Crossings.....	83
10.3	Car Park Design	84
10.3.1	Non-domestic Parking Areas and Design Standards.....	84
10.3.2	Design Vehicles	84
10.3.3	Layout Compliance	84
10.3.4	Travel Paths for Pedestrians, Cyclists and Persons with Disabilities .	85
10.3.5	Access Driveways.....	85
10.3.6	Vehicular Control Points and Gates	85
10.3.7	Elevated Ramps and Ramps to Basements.....	85
10.3.8	Vehicular Traffic Control.....	86
10.3.9	Commercial Vehicle Manoeuvring.....	86
10.3.10	Protection of Pedestrians.....	86
10.3.11	Shopping Trolley Bay Locations	87
10.3.12	Bicycle Parking Facilities.....	87
10.3.13	Pavement Surfaces.....	88
10.3.14	Gradients for Pavement Areas	88
10.3.15	Signs.....	89
10.3.16	Landscaping	89
10.3.17	Surface Drainage.....	89
10.4	Footpaths and Shared Paths	90
10.4.1	Design Standards and Guidelines.....	90
10.4.2	Designing for Pedestrians and Mobility Impaired People.....	91
10.4.3	Paths in Road Reserves	91
10.4.4	Public Paths Not in Road Reserves	91
10.4.5	Public Pathways used as Overland Flow Paths	92
10.4.6	Pathways used as Shared Bicycle Facilities.....	92
10.4.7	Ramps and Stairs	93
10.5	Shared Paths, Cycleways and Bicycle Facilities	93
11	Stormwater Drainage Design	95
11.1	General.....	95
11.1.1	Introduction.....	95
11.1.2	Design Life.....	95
11.2	Responsibilities.....	95
11.2.1	General Requirement.....	95

11.2.2	Standards	95
11.3	Interpretation.....	96
11.3.1	Abbreviations	96
11.3.2	Definitions	96
11.4	Pre-design Planning.....	97
11.4.1	Land Use Planning.....	97
11.4.2	Stormwater Management.....	97
11.5	Consultation.....	98
11.5.1	Council and Other Authorities	98
11.5.2	Utilities Service Plans	98
11.5.3	Calculations	99
11.5.4	Major Structures.....	99
11.6	Design Criteria – Stormwater Drainage Systems	99
11.6.1	Overall Design	99
11.7	Design for Stormwater Harvesting and Re-use	100
11.7.1	Roofwater	100
11.7.2	Stormwater Runoff	101
11.7.3	Stormwater Collection Requirements	101
11.7.4	Stormwater Storage Requirements	101
11.7.5	Stormwater Treatment Requirements.....	101
11.7.6	Stormwater Distribution Requirements.....	101
11.8	Hydrology	101
11.8.1	Design Rainfall Data Requirements	101
11.8.2	Additional Requirements	102
11.8.3	Catchment Area	103
11.8.4	Methods of Analysis	104
11.8.5	Alternative Models and Computer Analysis	105
11.9	Hydraulics.....	105
11.9.1	General.....	105
11.10	Design Philosophy	107
11.10.1	Minor System.....	107
11.10.2	Major System.....	107
11.10.3	The Major/Minor Stormwater Systems	112
11.10.4	Provision for Failure	112
11.10.5	Natural Drainage Paths.....	112
11.10.6	Surface Flows	113

11.10.7	Interallotment Drainage.....	113
11.11	General Requirement for Developments	113
11.11.1	New Developments.....	113
11.11.2	Redevelopment of Existing Developed Sites.....	114
11.11.3	Stormwater System Augmentation	114
11.11.4	Stormwater Inlet and Outlet Discharge.....	115
11.11.5	Landscaping and Stormwater Infrastructure.....	115
11.11.6	Maintenance	116
11.12	Hydrology	116
11.12.1	Design Principles	116
11.12.2	Design Exceedance Probability (AEP)	116
11.12.3	Impervious Area Assumptions	117
11.13	Road Drainage.....	118
11.13.1	Road and Street Network.....	118
11.13.2	Surface Flow Criteria	118
11.13.3	Major Traffic Routes.....	124
11.13.4	Protection Drains	124
11.13.5	Pedestrian Underpasses.....	124
11.14	Stormwater Drainage Systems	125
11.14.1	General Stormwater Drainage Conduit Requirements	125
11.14.2	Locations and Alignments	125
11.15	Gross Pollutant Traps (GPT) and Sediment Traps	127
11.15.1	General.....	127
11.15.2	Constructed Wetlands and Ponds.....	128
11.15.3	Buffer Strips, Vegetated Swales and Bio-retention Systems.....	129
11.15.4	Miscellaneous	130
11.15.5	Legal Point of Discharge and Right to Discharge Stormwater	131
11.16	Documentation.....	133
11.16.1	General.....	133
11.17	Stormwater Design Drawings.....	134
11.17.1	General.....	134
11.17.2	Other Documentation.....	135
11.18	Interallotment Stormwater Drainage.....	136
11.19	Interallotment Drainage.....	137
11.19.1	General.....	137
11.20	Stormwater Drainage Easements and Reserves.....	139

11.20.1	General Requirements - Easements	139
11.20.2	General Requirements Drainage Reserves.....	140
11.21	Hydraulic Design and Pipeline Design	140
11.21.1	Hydraulic Grade Line (HGL).....	140
11.21.2	Design Criteria	141
11.21.3	Grades.....	141
11.21.4	Minimum Pipeline Grades and Velocity	141
11.21.5	Maximum Grades and Velocity.....	141
11.21.6	Scour Stops, Trench Stops, Bulkheads	141
11.21.7	Vertical Angles	142
11.21.8	Allowable Pipe Diameters	142
11.21.9	Structural Design of Pipelines and Box Culverts	142
11.21.10	Reinforced Concrete Pipe and Box Culvert Class	143
11.21.11	Connection to Structures.....	143
11.21.12	Curved Pipelines.....	143
11.21.13	Dead End Pipelines	144
11.21.14	Interallotment Drainage Connections	144
11.22	Road Culvert Design.....	144
11.22.1	General.....	144
11.22.2	Major System Requirements.....	144
11.23	Stormwater Pits – Inlet and Junction.....	145
11.23.1	General.....	145
11.23.2	Council Standard Pit Types	146
11.23.3	Design Kerb Inlet Sizes.....	146
11.23.4	Location	147
11.23.5	Maximum Pit Spacing	148
11.23.6	Junction Pits	148
11.23.7	Provision for Blockage	148
11.24	Flow Path and Open Channel Design	148
11.24.1	General Requirements – Flow Paths.....	148
11.25	General Requirements – Open Channels	149
11.25.1	Location	150
11.25.2	Freeboard	151
11.25.3	Natural Channels	151
11.25.4	Grades.....	151
11.25.5	Advisory Signs	152

11.25.6	Batter Slope Requirements	152
11.25.7	Low Flow Provision	152
11.25.8	Erosion and Scour Protection	152
11.25.9	Special Provisions.....	153
11.26	Detention Basins.....	153
11.26.1	General.....	153
11.26.2	Analysis	155
11.26.3	Outlet Design	155
11.26.4	Embankment and Floor Slopes	156
11.26.5	Safety	157
11.26.6	Landscaping	157
11.26.7	Access	157
11.27	On-site Stormwater Detention	157
11.28	Major Structures	160
11.28.1	General.....	160
11.28.2	Box Culverts	161
11.29	Remote Supervision Signage.....	161
11.30	Work-As-Executed Stormwater Works	161
11.30.1	Work-As-Executed Documents	161
11.31	Final Certification of Completed Works	161
12	Control of Erosion and Sedimentation.....	162
12.1	Introduction.....	162
12.2	Responsibilities.....	162
12.3	Definitions General	162
12.4	Qualifications	163
12.5	Pre-design Planning.....	163
12.5.1	Planning.....	163
12.6	Site Erosion Risk Assessment	165
12.7	Site Sediment Risk Assessment.....	165
12.8	Land Capability Assessment and Site Actions Required	165
12.9	Consultation.....	165
12.9.1	Council and Other Authorities	165
12.9.2	Procure Approvals as Required.....	166
12.9.3	Other Project Development Team Members.....	166
12.10	Design Criteria	166
12.10.1	Classification of Unsealed Roads.....	166

12.10.2	Design Objective.....	166
12.10.3	Location of Unsealed Roads	167
12.11	Development Planning Considerations	167
12.11.1	Construction and Site Planning	167
12.11.2	Development Planning	168
12.11.3	State Legislation	168
12.11.4	State Guidelines and Other Referenced Documents.....	168
12.11.5	Site Evaluation Tools.....	169
12.12	Site Constraints	169
12.13	Drainage Control.....	170
12.13.1	Design Standards	170
12.14	Drainage for Unsealed Roads	170
12.14.1	Maximum Distance of Water Flow Along Unsealed Road Surfaces ..	171
12.15	Drainage Control Measures	171
12.15.1	Control Measure Selection Considerations	173
12.16	Erosion Control	173
12.16.1	Risk Assessment.....	173
12.17	Erosion Control Measures.....	174
12.17.1	Mulching	174
12.17.2	Erosion Control Blankets.....	175
12.17.3	Control of Soil Erosion on Slopes.....	175
12.17.4	Summary Application of Erosion Control Measures to Soil Slopes ..	175
12.17.5	Dust Control.....	176
12.17.6	Major Drainage Channels and Watercourse Stabilisation.....	178
12.17.7	Vegetation Management	178
12.18	Sediment Control	178
12.18.1	Design Standards	178
12.18.2	Design Objectives	178
12.18.3	Sediment Control Measures.....	179
12.19	Stockpile Management	182
12.19.1	General.....	182
12.19.2	Erosion Control Measures.....	182
12.19.3	Sediment Control Measures.....	182
13	Documentation.....	183
13.1	Submissions Process.....	183
13.1.1	Document Submission and Approval Process.....	183

13.1.2	Conceptual Erosion and Sedimentation Control Plan (ESCP) or Soil Water Management Plan (SWMP)	183
13.2	Statutory Documentation Requirements.....	183
13.2.1	Approvals.....	183
13.2.2	Approvals Conditions	184
13.2.3	Calculations	184
13.2.4	Program.....	184
13.2.5	Specifications.....	184
13.2.6	Design Certification.....	184
13.3	Drawings.....	184
13.3.1	Conceptual Erosion and Sedimentation Control Plan (ESCP) or Soil Water Management Plan (SWMP).....	184
13.3.2	Conceptual ESCP/SWMP scale: < 1:1000.	184
13.3.3	Construction Phase Drainage Plans	186
13.4	Supporting Design Documents	186
13.4.1	Calculations	186
13.4.2	Program.....	186
13.4.3	ESCP/SWMP Specifications	186
13.4.4	Design Certification.....	187
13.4.5	Additional Certification	187
14	Street and Public Place Lighting	188
14.1	General Requirements.....	188
14.2	Design Standards	188
14.3	Solar Lighting – Street Lighting and Pedestrian Areas	191
14.4	Poles and Fittings	192
14.5	Rural Road Lighting	192
14.6	Responsibilities.....	192
15	Utility Services Design and Installation.....	193
15.1	Design of Utility Services	193
15.2	Effects on Services	194
16	Landscaping and Street Tree Planting	196
16.1	Landscaping	196
16.1.1	Landscape Design Objectives.....	196
16.1.2	Landscape Design Guideline	196
16.2	Street Tree Planting	197
16.2.1	Street Tree Planting Objectives.....	197
16.2.2	Safety in Design.....	197

16.2.3	Design Life and Location.....	197
16.2.4	Permeable Pavement Systems and Root Vaulting	197
16.2.5	Landscape Design Guideline Street Tree Planting	198
16.3	State Roads.....	198
16.4	Tree Preservation	199
17	Design of Water Reticulation.....	200
17.1	Introduction.....	200
17.2	Minimum Standards for Water Reticulation Design	200
17.3	References	200
17.4	Classification of Mains and Areas for Water Supply	201
17.5	General Requirements Regardless of Area.....	202
17.5.1	Design	202
17.5.2	Servicing Strategy.....	203
17.5.3	Future Demands	203
17.5.4	Plans and Calculations	203
17.5.5	Structures	204
17.5.6	Locations and Cover	204
17.5.7	Mains in Cul-de-Sacs.....	204
17.5.8	Hydrant, Flushing Point and Stop Valve Chambers.....	205
17.5.9	Existing Stop Valves and Hydrants.....	205
17.5.10	Detector Tape	205
17.5.11	Tapping Bands	205
17.5.12	Water Meter Installation	205
17.5.13	Shared Trenching.....	206
17.5.14	Pipe/Fitting Connection.....	207
17.5.15	Pressure Reducing Valves	207
17.5.16	Opening of Valves.....	207
17.5.17	Thrust Blocks	207
17.6	Water Reticulation Areas.....	208
17.6.1	Minimum Requirements	208
17.6.2	Water Demand.....	208
17.6.3	System Components.....	208
17.6.4	Service Reservoirs.....	208
17.6.5	Static Head	208
17.6.6	Pipe Size	209
17.6.7	Mains and Fittings.....	210

17.6.8	Service Connections	212
17.7	Low Flow (Trickle Feed) Water Supply Areas	214
17.7.1	Minimum Requirements	214
17.7.2	Water Demand	214
17.7.3	System Components	214
17.7.4	Service Reservoirs	214
17.7.5	Pressure Head	214
17.7.6	Pipe Size	214
17.7.7	Pipelines in Trickle Flow Areas	215
17.8	Drawings - Water Reticulation System	216
18	Design of Sewer Reticulation Minimum Standards	217
18.1	Introduction	217
18.2	References	217
18.3	Gravity, Pump Out or Low Pressure	218
18.4	General Requirements	218
18.4.1	Design	218
18.4.2	Servicing Strategy	218
18.4.3	Future Loading	218
18.4.4	Plans and Calculations	219
18.4.5	Excavating or Building Adjacent to or Over Existing Sewer Mains...	219
18.5	Gravity Sewer	219
18.5.1	Locations and Cover	219
18.5.2	Materials	220
18.5.3	Property Connection	220
18.5.4	Junctions	221
18.5.5	Soffit Requirement	222
18.5.6	Inspection Shaft	223
18.5.7	Markings of Junctions and Sidelines	223
18.5.8	Access Chambers/Maintenance Holes	223
18.5.9	Existing Maintenance Holes and Services	224
18.5.10	Sewer Easements	224
18.5.11	Design Criteria	225
18.6	Rising Mains and Pumping Stations	227
18.6.1	Purpose	227
18.6.2	Design Flows	227
18.6.3	Rising Main Materials	227

18.6.4	Valves, Fittings and Vents	228
18.6.5	Pump Stations	228
18.7	Pressure Sewer	229
18.7.1	General.....	230
18.7.2	Standards and Regulations.....	232
18.7.3	Reticulation Zones	232
18.7.4	Design Criteria	232
18.7.5	Design Flows	232
18.7.6	Pump Duty Points	232
18.7.7	Mains and Fittings.....	232
18.7.8	Depth and Location of Pipework	234
18.7.9	Road Crossings	234
18.7.10	Location Markers	234
18.7.11	Residential Access / Driveways.....	235
18.7.12	Property Connections	235
18.7.13	Discharge Point to Council Sewers	236
18.7.14	Odour Suppression	237
18.7.15	Supply of the Unit.....	237
18.8	Building Over or Near Council's Sewer	237
18.8.1	Building Near Council Sewer	237
18.8.2	Building Over an Underground Gravity Asset.....	238
18.8.3	Types of Structures Where this Arrangement Applies.....	240
18.8.4	Asset Protection Measures	242
18.9	Zone of Influence	243
18.10	Clearances from Access Structures	244
18.11	Access Requirements	246
18.12	Swimming Pools and Retaining Walls	246
18.12.1	Above Ground Swimming Pool	246
18.12.2	In-ground Swimming Pool and Above Ground Permanent Structures	246
18.13	Retaining Walls	247
18.13.1	Filling Over Asset Mains.....	247
18.14	Excavations Over and Adjacent to Mains	247
18.14.1	Excavations	247
18.14.2	Earth Embankments	248
18.14.3	Abandoned Mains	248
18.15	Planting of Trees.....	248

Appendix A. Preparation and Presentation of Design Drawings.....	250
Appendix B. Preparation and Presentation of Works As Executed Drawings.....	259
Appendix C. Checklist – Water Reticulation Design.....	261
Appendix D. Checklist – Water Information to be Shown on Water Supply Design Drawings	262
Appendix E. Checklist – Sewer Design	265
Appendix F. Sewer Information to be Shown on Sewer Design Drawings.....	266
Appendix G. Stormwater Information to be Shown on Stormwater Design Drawings....	269

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1 Introduction

1.1 Background

The Hilltops Council Engineering Guidelines ('the Guidelines') outline the engineering standards to be used for infrastructure provided within the Hilltops Council Local Government Area.

Council requires that where a developer carries out civil engineering works in connection with a subdivision or development and the works later become the responsibility of Council, the works must be constructed in accordance with the Guidelines.

The Guidelines comprise:

- Section 1 Guidelines for Design
- Section 2 Construction Specification
- Section 3 Construction and Design Drawings (Parts A and B)
- Section 4 Construction Guideline

This document replaces the Hilltops Council (formerly Young Shire Council) Engineering Guidelines for Subdivisions and Developments (1994) and process standards utilised in former Boorowa and Harden Councils.

The previous Guidelines were part guide and part design manual. Council has moved towards a set of recognised industry standards with references to appropriate current external design manuals and guidelines.

The Guidelines use Auspec standard platforms and bring current approaches to design and construction. They also address issues that Council has faced in recent years, including premature failure of pavements and maintenance issues with relatively new pipelines.

It is the developer and designer's responsibility to keep abreast of changes in recommended current practise. Where a reference has been made to a particular document which has been superseded by a more recent document, the more recent document should be used.

1.2 Consultation with Council

Council encourages prospective applicants and their design consultant to meet with Council before starting the design process. This allows Council to discuss with the designers what is proposed and seek common ground before a significant start is made by consultants on detailed plans.

Applicants will be required to prepare a Traffic Engineering Report by a suitably qualified Traffic Engineer to assist in assessing the impact of the development on surrounding areas. The results of the report are to be incorporated into the detailed design.

Applicants are advised to ensure that all conditions of the Development Consent are addressed within the detailed engineering plans, as a Subdivision Certificate or Completion of Works Certificate cannot be issued until the conditions of consent have been met in full.

For similar reasons, developers are encouraged to consult early with Goldenfields Water (GW) regarding reticulated water supply to the proposed development where it is proposed to draw water direct from its mains. Consultation with Goldenfields Water at an early stage, with concept plans (complete with ground contours) will allow water supply related issues and developer contributions to be identified at an early stage in the development process.

1.3 Prior to Plan Preparation

1.3.1 General

Standards for subdivision and land development are rapidly changing in response to changing community and NSW State Government driven expectations that have an increased emphasis on:

- Community facilities, public open space areas, landscaping and urban design outcomes including pedestrian connectivity that is associated with new urbanism concepts
- Water-sensitive urban design, water conservation and stormwater quality
- energy efficiency and sustainability
- Community safety, particularly in public open space areas.

To assist in achieving these outcomes, approval will be merits-based and consider the overall impact of the development on the community and not solely on compliance with minimum engineering standards.

To encourage the submission of innovative design solutions and connectivity of services, Council staff are available for initial consultation to discuss and facilitate outcomes. In this context, development standards may be subject to variation with approval from Council where outcomes are linked to environmental and community benefits.

An important part of the planning approval process is the preparation of an overall master plan for larger developments that provides for the integrated provision of urban landscaping, roads, drainage, water, sewer, gas, lighting, telecommunications and electrical services.

The objectives of this are to ensure:

- Compliance with planning requirements
- That adequate information is provided at initial planning stages to allow orderly review and assessment of land development
- That developments provide effective and economical infrastructure that services the area.
- That staged or multi-developer projects are able to be delivered in a coordinated, safe, and efficient manner.
- That infrastructure is planned for the full potential of development and that unnecessary duplication or oversizing/undersizing of infrastructure is avoided.

To facilitate the expeditious approval of engineering plans, construction and Approved Plan of Subdivision release for subdivisions and developments the following approach is encouraged:

- Prior to commencement of design, meet with Council to discuss engineering development issues.
- Integrate subdivision work with infrastructure, urban design and community master planning. Submit a master plan (where applicable) of the overall subdivision development for inclusion in Council's mapping system.
- Demonstrate the application of quality assurance procedures when submitting designs and documents to Council for review with independent documented review by experienced staff prior to submission.

- Council review will then focus on general compliance with strategy and these guidelines.

Legislation on workplace and public safety during construction is now quite specific. Thus, the importance of safety of the general public, contractor's employees, subcontractors and road users on adjacent streets or accesses utilised during the project is critical.

Details of how this is to be achieved are to be included in the project drawings and in the project specifications.

1.4 Engineering Drawings and Specifications

1.4.1 Submission of Engineering Drawings

1.4.1.1 Initial Development/Project Discussion

In the first instance, developers and consultants are encouraged to meet with Council staff prior to commencement of design to discuss engineering development/project issues. This initial discussion is to review the development proposal and to inform the developer/consultant of specific requirements relating to the parcel of land/road reserve under consideration. This discussion should include but not be limited to:

- Existing features that may impact on the engineering design, including trees, historical items, topographical features, and otherwise significant features.
- Natural and proposed drainage flow paths.
- Export of material away from the site
- Extent of impervious surfaces
- Consideration of onsite waste management systems
- Existing car parking, footpaths and landscaping
- Proposed road layout, hierarchy and carriageway widths, based on a Traffic Engineering Report covering predicted traffic volumes, traffic generating facilities and other relevant information. The report should consider the impact on the overall neighbourhood, not just the subdivision in question. existing roads, to allow for future arterial roads and utility corridors
- Proposed intersection treatments considering the Traffic Engineering Report recommendations
- Proposed lot layout
- Proposed open space and linkages, recognising the importance of access for all users, seeking to avoid proximity to major roads, with good sight surveillance lines, and preferably with overall frontage to at least 3 streets and avoidance of bordering rear yards
- Footpath and car parking details including mobility access
- Identification of commercial, social and community infrastructure requirements and traffic generating development, based on a master plan and the Traffic Engineering Report
- Landscaping, including proposed vegetation, irrigation areas and significant furniture
- Street lighting
- Stormwater drainage

- Sewerage drainage
- Water-sensitive urban design treatment
- The impact of flooding
- The provision of facilities in accordance with any approved strategy or plan for a particular area.

1.4.2 Submission of Construction Specification

The specification is the responsibility of the applicant and is to include reference to requirements contained within the Guidelines, together with the appropriate standard specifications selected from other relevant sources.

Specifications should reflect best industry practice. Proposals may utilise Councils specifications contained in the Engineering Guideline suite of documents.

Specifications must be supplied with the drawings to allow site assessment of works.

1.4.3 Approval of Engineering Drawings and Construction Specification

Council or an accredited certifier will review the Detailed Engineering Drawings and Construction Specification for compliance with these guidelines. It is the responsibility of the applicant to ensure that the designs and specification are technically correct and comply with the following:

- Council's Engineering Guidelines
- Relevant Australian standards
- Relevant Austroads guidelines
- Relevant Local, State and Federal Government Legislation
- Conditions relating to the development consent for the subdivision

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

The development consent approval is current for five years. If work has not substantially commenced inside the period of currency of the development consent, Council may require that revised drawings and specifications be submitted for approval with the new Development Application. The developer will be required to comply with the current Guidelines.

1.4.4 Commencement of Works

Before the Developer commences the civil engineering works, detailed engineering drawings and construction specification of the proposals shall be submitted to and approved by Council or an accredited certifier, and the Council or an accredited certifier advised of a contact for the construction contractor.

Once a Construction Certificate/Subdivision Works Certificate is issued and before the site works are commenced, Council must be notified at least two days prior to commencement (section 81a (2)(b) of the EP&A Act). It's expected that an initial startup meeting between council and contractor staff is held at this point.

1.4.5 Developer's Responsibility

When consent for a subdivision or other development includes conditions of construction which are embodied in the development consent, approved plans and specification, the onus is on the applicant to whom the approval is given to ensure that the work is completed in accordance with the plans and specifications, relevant permits, meets workplace safety regulations and is to the satisfaction of Council or an accredited certifier.

The Approved Plan of Subdivision will not be released until the engineering works (including Works As Executed plans) are completed and all other conditions of the development consent are satisfied (section 109J (2) of the EP&A Act).

The contractor carrying out subdivision works is responsible to the developer, not Council, for constructing and maintaining the works to the approved standards to the satisfaction of the Council or accredited certifier.

Council retains the right to audit any development control process or activity and ensure that works are carried out in accordance with the approved plans and specification.

The works and the works site are the responsibility of the developer prior to the asset being formally handed over to Council.

1.5 Inspection of Works

1.5.1 Inspection and Uninterrupted Access

The whole of the road, drainage, kerb and gutter, water supply and sewerage construction works, which the developer is required to carry out in respect of a development, will be inspected under the direction of Council or an Accredited Certifier.

All works shall be carried out to the entire satisfaction of the Council or accredited certifier. The developer/ contractor is to provide uninterrupted access for the examination of any facilities, works and materials as requested by Council or the accredited certifier.

No works can commence until Detailed Engineering Plans have been approved. The first works shall include implementation of the Sedimentation and Erosion Control Plan. From time to time, Council will audit elements of the work and hence Council or its agents will require uninterrupted access to the site. The cost of such audits will be at Council's expense, but items requiring alteration or inclusion will be at the developer's cost.

The developer and accredited certifier will be given 24 hours' notice of such audits.

1.5.2 Public Safety

The developer will be held responsible for the safety of the public to the extent that the works being undertaken influence or impact on the safe and efficient passage of the public around and/or through the works. The developer shall not obstruct the free passage of the public unless public safety is at risk and no other means of ameliorating that risk is readily available.

The developer shall provide all traffic control, lights, barriers, signs and fences necessary to prevent any accidents to the public or private damage or loss. The developer shall provide, erect and maintain all necessary signs, temporary roads, bridges, footways, drains and trench supports, fences and protection to ensure the above.

1.5.3 Damage to Services

The developer must enquire as to the location of all services with Dial Before You Dig or the relevant utility authority. Where proposed works have the potential to conflict with services, the services must be physically located on site and documented on plans.

In the event of any of the above-mentioned services being damaged or interrupted, the developer shall forthwith notify the responsible utility and take all necessary steps to provide for the safety of the public and to have the damage repaired as quickly as possible. The cost of all repairs is the responsibility of the developer.

1.5.4 Traffic Control

The developer shall prepare and implement an approved Traffic Management Plan (TMP) that incorporates a Traffic Guidance Scheme (TGS) by an Accredited Traffic Management Provider to ensure safe, continuous movement of traffic with a minimum of disturbance in public roads, and provision for pedestrian traffic. Signs, barricades, barriers, warning lights and other devices shall be placed where works are in progress in accordance with the following:

- TfNSW Traffic Control at Worksites guidelines
- Austroads Temporary Traffic Management for Static and Mobile works (ATTM03-26 and ATTM04-26)
- AS 1742 – ‘Manual of Uniform Traffic Control Devices’

1.5.5 Fire Fighting Provision

The developer shall provide and maintain adequate firefighting equipment and take adequate fire protection measures during the works and shall take action to prevent damage to, or destruction by fire of bushland trees, shrubs or grasses.

In urban areas, any fire hydrants or stop valves in the road reserve adjacent the works shall not be obstructed and must be kept clear at all times.

1.5.6 Work within Railway Property

Before starting any work across a railway line or railway property, the developer shall obtain from the State Rail Authority or their agent, an approval in writing to commence such work. The developer shall comply with all requirements of the State Rail Authority and complete such work to the State Rail Authorities satisfaction.

1.5.7 Notification

The developer must provide to Council or an accredited certifier the name, address and contact telephone number of the contractor at least seven days prior to the proposed date of commencement of any construction.

The developer shall provide to Council or an accredited certifier forty-eight (48) hours prior notice in respect of nominated PCA Inspections the following:

- Completion of formwork/stringlines for kerb and gutter
- Opening of trenches ready for pipe laying
- Placing of pipes in trenches prior to backfilling
- Placing and pouring of concrete

- Testing of sewer and water mains
- Completion of subgrade preparation before placing of pavement
- Completion of each pavement layer ready for proof rolling and compaction testing and level conformance.
- Sealing of roadworks.

The developer shall, if required by Council or an accredited certifier, submit dockets from the supplier of asphalt and/or ready-mixed concrete and test results in order that the quality of the supplied product may be checked.

The developer shall provide written advice from its geotechnical consultant that the subgrade and pavement are to specification prior to bitumen sealing, asphalt concrete or concrete of the road/s.

The developer shall, within seven days of the bitumen sealing of any pavement, supply to Council or an accredited certifier all supply dockets and spraying records in respect of such work.

Council or an accredited certifier shall inspect the works to ensure that the works are constructed in accordance with Council requirements and the approved plans.

Council or an accredited certifier does not carry out the functions of 'Superintendent' as defined in the General Conditions of Contract - AS 2124, The developer is required to appoint a consultant to carry out this function if deemed appropriate to do so.

1.6 Fees and Contributions

1.6.1 Subdivision/ Development Inspection Fees

Fees for examination of detailed Engineering Drawings and Inspection of Subdivision works are as prescribed by Council's Fees and Charges.

For those developers who elect to use Council for the inspection of subdivision works, the fees for these inspections must be paid in full prior, in addition to the full execution of the Principal Certifying Authority (PCA) contract between the developer and Council prior to the inspections are carried out.

1.6.2 Services/Facilities and Headworks Contributions

The services provided by Council for which developer contributions may be obtained under Section 94 of the *Environmental Planning and Assessment Act 1979* and Section 64 of the *Local Government Act 1993* include:

- Roads and traffic management facilities
- Open space and recreational facilities
- Community facilities
- Commercial centre car parks
- Stormwater drainage
- Sewerage
- Water supply (contributions are payable both Council and Goldfields Water).

These contributions are payable in full prior to the release of the Approved Plan of Subdivision or as prescribed by the development consent and are based on the current Section 94 and Section 64 Contribution Plan.

Works associated with the Section 94 and Section 64 developer contribution plans are as described in detail in those documents.

1.6.3 Testing of Works

Testing for compliance of works with the drawings and specifications shall be undertaken by the contractor or nominated sub consultants as part of a Quality Assurance Program as approved by Council or an accredited certifier and as specified in this document.

Council may prescribe additional tests to determine that acceptable standards of workmanship have been achieved in relation to its interests in the subdivision but otherwise the full cost of quality assurance testing will fall onto the contractor and/or developer.

Where additional tests show that acceptable standards of workmanship are not being achieved all additional testing costs will be at the developer's cost.

1.7 Bonds and Guarantees for Performance

The Approved Plan of Subdivision will not be signed and released by Council or an Accredited Certifier until certification is provided that all engineering works, including water reticulation, have been satisfactorily completed and signed 'Work As Executed' drawings are provided to the satisfaction of Council. This is to include a full detailed list of asset related items and costs thereof.

A maintenance bond is required from the developer to be paid in full prior to the release of the Approved Plan of Subdivision to the value of five percent of the contract price of the subdivision or as prescribed by the development consent or Section 68 approval. The developer is to submit a copy of the successful tenderer's bid for the construction or a schedule of actual costs of the subdivision works to allow this bond to be determined.

The maintenance period shall be held for a period of 12 months from the date of when the subdivision is accepted into maintenance, subject to satisfactory rectification of any required maintenance.

Bank guarantees shall not have expiry dates.

The acceptance of bonds and guarantees for performance are at the discretion of Council.

1.7.1 Deferred Works

Subject to mutual agreement between the developer and Council, where Council determines that it is not practical to physically construct works and that the deferment of works will result in improved community outcomes through co-ordination with other works, Council may consider a payment equivalent to the full cost of construction of the works. Deferred works typically relate to tree plantings and driveway works.

1.8 Works-As-Executed

Following the completion of engineering works in a subdivision or development, Works-As-Executed (WAE) plans are to be prepared and signed off by a Registered Surveyor or Certified Professional Civil Engineer and forwarded (business details and registration/certification number/s to be shown) to Council prior to the release of the final plan of subdivision.

WAE plans shall show only the current stage of works that has been constructed (existing or future stages of subdivisions works must not be included in the WAE plans). The WAE plans must be certified by a Registered Surveyor or Certified Professional Civil Engineer and shall include the following:

- 1 full set of electronic coloured stage drawings in Adobe pdf format formatted to A3 size if printed
- Notation that all works have been completed in accordance with the approved plans and specification (including approved variations and amendments)
- Clear notation of any departure from the approved plans
- Notation of any additional work or works deviated from approved design that has been undertaken shown in red.
- WAE levels on all longitudinal sections, kerb returns, swale drains and tail-out structures
- location of conduits, subsoil lines, stub mains and inter-allotment drainage lines, etc.
- WAE levels on drainage and sewer pipeline longitudinal sections, showing the constructed invert levels of each pipe at each pit/manhole, pipe size and pit dimensions.
- Stop valves, hydrants, meter locations and other valves associated with water supply.
- WAE levels along swale and tail-out drainage
- WAE levels along road centrelines and kerb returns
- WAE levels about cross sections.
- Location (including footprint) of any site fill, the natural surface levels, finished surface levels and compaction achieved
- All other details which have a bearing on the extent of works and their acceptance by Council including telecommunications, gas and electricity utilities.

WAE locations of sewer maintenance holes, sewer junctions, inter-allotment drainage inlet points and stormwater drainage pits. Information must also give assurance that the component of the pit below the precast pit top is located and orientated correctly, in accordance with the approved plan.

CCTV is to be used in accordance with applicable standards to locate all sewer junctions and confirm the integrity of the installation. An electronic file format record is to be provided to Council as part of the conditions of compliance of the works.

location and depth of services using survey accuracy GPS equipment, submitted to Council in electronic format appropriate for overlay on Council's mapping system.

The following certificate is to be appended to each page of the plans and signed by the registered surveyor or professional engineer:

** I hereby certify that engineering works shown on the plan are Works-As-Executed and have been constructed in accordance with the plans and specifications approved by Council/Accredited Certifier (strike out whichever is inapplicable).*

Name:

Signature:

Capacity:

Date:

The registered surveyor responsible for the Approved Plan of Subdivision covering the subdivision is to supply a signed certificate stating that all pipes and associated pits are located wholly within the respective easements or street allocation as per the approved engineering plans. This certificate must be supplied before the Subdivision Certificate will be issued.

A statement certifying that all works have been completed in accordance with the construction certificate must be produced with the WAE before the Subdivision Certificate is released.

An electronic copy of WAE plans is to be supplied by the developer in current Asset Design and As Constructed (ACAD) format.

1.9 Handover of Completed Works

1.9.1 Notification of Completion

When the developer is of the opinion that subdivision works have been completed, arrange an inspection with Council's Development Engineer. Within fourteen days of the receipt of the request, Council or an accredited certifier shall inspect the works and shall issue an Interim Compliance Certificate for the works or shall give the developer, in writing, the reasons for not issuing the above. The developer or his agent shall be present for the inspection and assist Council or an accredited certifier with the checking of levels and opening of pits/maintenance holes etc., as required.

1.9.2 Maintenance of Works

The Maintenance Period (Defects Liability Period) will be twelve months and will commence on the date of the issue of the Maintenance Certificate.

The Maintenance Bond will be to the value as described above. This bond will be held by Council to cover any defects or omissions, which may arise or become apparent in the Maintenance Period.

At any time during the Maintenance Period, the Council may direct the developer to rectify any omission or defect in the work, which exists at Practical Completion or becomes apparent prior to the expiration of the Maintenance Period. If defects or omissions are not rectified to the satisfaction of the Council, the Council will be at liberty to rectify the same and apply the maintenance bond for payment of the cost thereof.

The nature of some defects, e.g. water main breaks, may necessitate the Council's immediate repair. The maintenance bond may be used for the costs unless the developer elects to pay the Council separately.

1.9.3 Release from Maintenance Period

Shortly before the end of the Maintenance Period there will be a joint inspection which will require five working days' notice. Following the inspection and any necessary rectification works, Council will forward a Final Compliance Certificate and arrange for release of any bonds or guarantees that may be in place.

1.10 Survey and Setting-out Requirements

1.10.1 Centreline Marking

1.10.1.1 Urban

The centreline of the proposed road shall be set out at a maximum spacing of 20 metres.

Recovery pegs shall be placed on both sides of the road (off-set approximately 15 metres) at each curve tangent point, intersection, and at spacing of no more than 150 metres on straights.

1.10.1.2 Rural/Rural Residential

The centreline set out shall be as required for urban roads except that the spacing shall be 30 metres and the provisions of TfNSW standards shall apply in respect to the pegging of curve transitions. Comply with longitudinal and cross-sectional intervals in Hilltops Council Engineering Guideline Design of Roads.

1.10.2 Datum and Co-ordinates

The survey shall be undertaken on Australian Height Datum and MGA co-ordinates as stated in the Hilltops Council Engineering Guideline Design Section.

1.10.3 Bench Marks

Bench Marks shall be established within the works area at intervals not exceeding 100 metres and in accordance with sound surveying practice.

1.10.4 Survey Control Marks

All plans of survey are to show connection to at least two survey control permanent marks where such exist in the vicinity of the subdivision or where practicable. In the case where it is intended to open a new road at least two control marks per sheet of the subdivision plan are to be established in the road by the registered surveyor and connected to the nearest allotment corner.

The survey control marks shall be in accordance with the Survey & Spatial Information Regulation 2012 as amended.

Two copies of the locality sketch plans of the marks placed are to be forwarded to Council with the Approved Plan of Subdivision.

1.10.5 Lot Boundaries

Lot boundaries shall be established after the final trim, to the standard required by Survey & Spatial Information Regulation 2012, prior to the final inspection of works.

2 Glossary of Terms

Throughout the guideline, the following definitions and interpretations shall apply:

Access Road - Minor Road which carries a low volume of traffic, providing direct access to a limited number of allotments.

Accredited Certifier - Person who holds a certificate of accreditation under the Building Professionals Act 2005 in relation to particular matters. An Accredited Certifier in general may issue Compliance Certificates for matters within their area of accreditation.

Note: An Accredited Certifier may not certify construction in respect of water and sewer works pursuant to Section 306 of the Water Management Act 2000. Works on public roads under the Roads Act 1993 may preclude an Accredited Certifier from being appointed. In the case of the provision of water and sewer servicing, Council will issue a Section 307 Certificate of Compliance under the Water Management Act 2000 when requirements have been met.

ADT – Average Daily Traffic - vehicle counts and classification over a short period of time.

AADT – Annual Average Daily Traffic - vehicle counts and classification for a period of a year.

AEP - Annual Exceedance Probability.

Ancillary Road Asset - Road elements including kerb and gutter, drainage pits, drainage lines, subsoil drainage lines, pavement markings and street furniture.

Applicant - Person or corporation making application to Council for approval for a proposed development.

ARR - Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia (latest online edition).

Asset - Physical component of a road system or network. An asset is considered worthy of separate identification if it delivers services or benefits to the community of sufficient current or future value to warrant control and management on an individual basis. Typical assets include sections of pavements, bridges, culverts, traffic signals, signs, road furniture, road reserves, etc.

ATP – Active Transport Plan - adopted by council covering pathways and related infrastructure.

Australian Height Datum (AHD) - Datum surface approximating mean sea level as adopted by the National Mapping Council of Australia in May 1971.

Authorities - Authorities such as Department of Planning and Environment, Transport for NSW, NBN co. Telstra, Optus, Essential Energy, Jemena, etc.

Blue Book - Managing Urban Stormwater: Soils and Construction, 4th Edition, Landcom, 2004.

BPA – Bushfire Prone Area.

Carriageway - Portion of road or bridge used by vehicles (including shoulders and auxiliary lanes or between the face of kerbs).

CBR - California Bearing Ratio – soil test result to determine underlying soil strength.

Certifying Authority - A Certifying Authority may be Council, or an Accredited Certifier approved by Council.

Collector Road - Road linking access roads to major roads, possibly providing bus routes and giving road access to allotments.

Consulting Geotechnical Engineer - An experienced and qualified person or company holding an appropriate level of professional indemnity insurance, engaged by the Service Provider to provide advice, inspection reports and recommendations and testing as required by various parts of this Specification in relation to geotechnical matters.

Contractor - Person, private sector entity or consortium engaged by a Developer or Service Provider to execute a contract.

Council - Hilltops Council. Council may also be referred to as the Principal under a Construction Contract.

Council's Representative - Staff member nominated by Hilltops Council to act on Council's behalf in the discharge of its contractual responsibilities and/or the person responsible/delegated to decide for Council. This person may be referred to as the Superintendent under a Construction Contract.

CPI - Consumer price index.

Cycleway - Portion of a road or footpath devoted to the use of bicycles.

DA - Development application.

DBYD - Dial Before You Dig.

DCP - Development Control Plan.

Design - In relation to plant or a structure, it includes a design of part of the plant or structure and redesign or modification of the design.

Detention Basin (Retention/Retarding Basin) - Storage Pond, basin or tank used to reduce and attenuate the peak discharge within a drainage system. **Driveway** - Part of an access to/from a road or road related area, which is completely within the adjacent land.

Developer - The person who will contract, arrange or facilitate the construction work and/or the owner of the land on which the construction work is proposed

Development - Approved works to be carried out by the Applicant.

Development Application (DA) - Application for approval to carry out building, engineering or other works as defined in the Local Government Act.

Development Consent - Consent under Part 4 of the EP&A Act, to carry out development and includes, unless expressly excluded, a complying development certificate.

DCP - Development Control Plan

Director and or Director of Infrastructure - The Council Director responsible for engineering works.

Distribution and Trunk mains - Are those pipelines which transfer water to reservoirs, link reservoirs or areas of demand, or distribute water to, or through areas of development.

Drawings - Documents presenting information in pictorial form, with or without text, including drawing view, longitudinal sections, elevations, cross sections and other detail as necessary to fully describe the works to be carried out.

Engineer - (Civil, Geotechnical, Structural, etc) - Where used in this document refers to a person of suitable experience (as a guide not less than 10 years industry experience), who holds an appropriate level of professional indemnity insurance and qualifications to

undertake the relevant elements of the work and are eligible for corporate membership of the Institution of Engineers, Australia (or equivalent professional industry body).

EP&A Act - The *Environmental, Planning and Assessment Act 1979* as amended

Equivalent Standard Axles (ESA) - A Dual Tyred Single Axle transmitting a load of 80kN (or 8.2 tonne) to the pavement.

EV – Electric Vehicle

EY - Exceedance per year.

Floodplain - As defined by the current NSW Government Floodplain Development Manual. Area of land, which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.

Floodway Areas - As defined by the current NSW Government Floodplain Development Manual. Those areas of the floodplain where a significant discharge of water occurs during floods. They are often aligned with naturally defined channels. Floodways are areas that, even if only partially blocked, would cause a significant redistribution of flood flow, or a significant increase in flood level.

Floodway - As defined by Austroads. A longitudinal depression in a carriageway specially constructed to allow the passage of floodwater across it without damage. The cross section of a stream in flood plus a nominated area for freeboard.

Footpath - Path or paved area reserved for the movement of pedestrians and manually propelled vehicles and motorised mobility devices.

Geocentric Datum of Australia (GDA) - GDA 2020

Handover Documents - All documents provided by the Service Provider to Hilltops Council on Practical Completion as specified, including WAE drawings.

Hydrant – valve required to gain access to water supply system for firefighting and maintenance purposes.

Intensity Frequency Distribution (IFD) - A mathematical function that relates the rainfall intensity with its duration and frequency of occurrence

IPWEA Specification - Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage.

Kerb and Gutter - Combined roadside element forming an open drain to capture and discharge runoff. The term kerb and channel were adopted by TfNSW to align with Austroads and other Australian States and Territories and may be used interchangeably with the term kerb and gutter.

Lane - Portion of the paved carriageway marked out by kerbs, painted lines or barriers, which carries a single line of vehicles in one direction. A lane is generally between 3.0 and 3.5m wide. A single carriageway road normally has at least one lane in each direction.

Late Fee - Any unauthorised work will incur a late fee in accordance with Council's Fees and Charges.

LEP - Local Environmental Plan.

LG Act - The *Local Government Act 1993* as amended.

LGA - Local Government Area.

Local Area Traffic Management (LATM) - Management of road space usage within a local area to reduce traffic volumes and speeds in local streets, to increase amenity and improve safety and access for residents, especially pedestrians and cyclists.

Local Distributor Road - A Road linking access roads to major roads, providing bus routes and giving restricted access to allotments.

Local Road - Minor Road which carries a higher volume of traffic than an access road but still provides direct access to allotments.

Map Grid of Australia (MGA) - Rectangular co-ordinate system using a Universal Transverse Mercator (UTM) projection based on the Geocentric Datum of Australia (GDA).

Masterplan - Is a non-statutory document that outlines a vision to guide growth and development of a centre or an area over a specified period. Ideally adopted by Council.

MGA Coordinate System - Map Grid of Australia (MGA). This is a standard Universal Transverse Mercator (UTM) projection and is used by all states and territories across Australia.

NATA - National Association of Testing Authorities, Australia.

Nature Strip - The area of the road reserve between the carriageway and property boundary.

NCC - National Construction Code, which comprises of the Building Code of Australia (BCA) as Volumes 1 and 2 and the Plumbing Code of Australia (PCA) as Volume 3.

NSWRFS - NSW Rural Fire Service.

Obstruction - Any object which could impede or prevent the free and/or safe passage of pedestrians and/or vehicles.

Operating Speed - The 85th percentile speed of cars at a time when traffic volumes are low, and which allows a free choice of speed within the road alignment as defined in the Austroads Glossary of Terms.

PAMP - Pedestrian Access and Mobility Plan now known as the Active Transport Plan (ATP).

Path - Footpath or shared path (refer to each respective definition).

Pavement Design Report - A geotechnical document outlining the materials found on site. Prescribes the required pavement layers in terms of thickness and material that forms the pavement. It also includes surface finish and any site abnormalities to be highlighted during construction.

PSD – Pedestrian Sight Distance.

Permanent Restoration - Restoration in accordance with Council's Specification is applied to the road or path after a temporary restoration has completed and left exposed to the public for a specified period.

Permanent Survey Mark (PSM) - Survey mark in the style or form for a permanent survey mark as described in the NSW Surveying and Spatial Information Regulation 2017.

PMF – Probable Maximum Flood.

Practical Completion - That stage in the execution of work under a Contract or capital works project when the works are complete except for minor omissions and minor defects that do not prevent the works from being reasonably capable of being used for their intended purpose, as determined by Council's Representative. This definition excludes Developer-constructed works as approved by a Development Consent.

Principal Certifier - For subdivision work, means the certifier appointed as the Principal Certifier under section 6.12(1) of the *Environmental Planning and Assessment Act 1979*. A Service Provider must appoint a Principal Certifier for each development project involving a subdivision. For the purposes of this Design Guideline, Principal Certifier could also mean the Principal Certifying Authority.

Principal Contractor - Under the *Environmental Planning and Assessment Act 1979* for building work is that person responsible for the overall co-ordination and control of the carrying out of the building work. A Principal Contractor may also be required under the Work Health and Safety Regulation 2017. The Service provider shall advise Council prior to commencement of any works who is the Principal Contractor in respect of both. In this Specification the Principal Contractor may also be referred to as “the Service Provider”.

The Service Provider undertaking construction work for Hilltops Council shall be appointed as the Principal Contractor and accepts all the obligations associated with this role under the Work Health and Safety Act 2011 and Work Health and Safety Regulation 2017.

Private Property - Property outside of the project, site boundary or road reserve. This is generally neighbouring property owned or leased by private owners and tenants.

Project Manager - The Service Provider shall appoint a person as the Project Manager for the Project. This person must be readily available and have sufficient authority and ability to discuss and resolve problems and act as the principal contact with Council’s Representative. A Service Provider who chooses to adopt this role must be aware that Council does not become involved in co-ordinating activities or giving advice beyond Council responsibilities. The Service Provider’s Project Manager may also be referred to as the Service Provider in this Guideline.

PRV - Pressure reducing valve.

Proponent - Person or service provider that puts forward a proposal to undertake work.

Public Road - A road opened or dedicated for the free right of passage of the public on foot, in a vehicle, or otherwise, (together with the right to drive stock or other animals along its length) is declared to be a public road for the purposes of the *Roads Act 1993* or any other Act.

Registered Certifier - a person who is registered under the *Building and Development Certifiers Act 2018*.

Register Surveyor - A person registered under the *Surveying Act, 2002*, as amended.

Restoration Order - Request to Council to undertake permanent restoration on behalf of a service provider.

Risk - The effect of uncertainty on objectives, as defined in AS/NZS ISO 31000:2009.

Roads Authority - National or State Road authority, Local Government, or any other individual responsible for the care, control and maintenance of road infrastructure.

Road Opening - Any form of excavation or digging of the road reserve including test bores for Geotechnical investigation purposes.

Road Occupancy Licence - A Road Occupancy Licence (ROL) is required for any activity likely to impact traffic flow, even if that activity takes place off-road on a declared state highway.

Road Opening Permit - Permit authorising the holder to undertake a road opening activity.

Road Pavement - Refer to definition for Carriageway.

Road Reserve - Legally defined area of land between the legal road boundaries within which facilities such as roads, paths and associated features may be constructed for public travel. Where roads have not been formed, it also refers to so called 'paper roads'.

RSA - Road Safety Audit undertaken by a suitably qualified road safety auditor.

RPZD - Reduced Pressure Zone Device

Safety Barrier - Physical barrier separating roadside hazards or opposing traffic and the travelled way, designed to resist penetration by an out-of-control vehicle and as far as practicable, to stop or redirect colliding vehicles.

Safework NSW - The Statutory body for work health and safety regulation.

Scour Valve - valve used to release contents of pipe for maintenance activity.

Seal design - A document describing the bitumen seal wearing surface that is constructed over the pavement layer of a sealed road.

Service line - pipe line provided solely to provide a water service to a lot.

Service Provider - Any parties such as contractors, suppliers, consultants (accredited certifier), developers, authorities, or Council staff responsible for planning, designing and constructing works.

Shall - Is used to indicate a requirement of Council that must be complied with under any conditions specified.

Shared Path - Paved area particularly designed (with appropriate dimensions, alignment and signing) for the movement of cyclists and pedestrians, but on which cyclists must give way to pedestrians.

Site - Land and structures within the extent of works area/site boundary, including storage areas. The site area may also include privately owned property that shall be dedicated to Hilltops Council as a public asset.

SOP - Standard Operating Procedure.

Specification - Detailed statement of materials, dimensions and quality for all work that shall be built, installed, or manufactured for Hilltops Council or for work which shall be dedicated to Hilltops Council as a public asset.

SSD – Stopping Sight Distance.

SISD – Safe Intersection Sight Distance.

State Survey Mark (SSM) - A form of Permanent Survey Mark as described in the NSW Surveying and Spatial Information Regulation 2017.

Stakeholder - An individual or group of individuals such as employees, directors, developers, service providers, consultants and external organisations who have an interest in the project whether through their involvement with the project or because they will be impacted by its outcome.

Stop Valve - valve to isolate stop water flow in a section of main

Subdivider - The owner of the land being subdivided

Subdivision - The division, by a landowner, of all or parts of a parcel of land into separate allotments of land, each with a separate title.

Subdivision Works Certificate (SWC) - Certificate issued under Section 6.4 of the EP&A Act.

Sub-contractors - Contractors engaged by the Principal Contractor. The identity of proposed sub-contractors and their proposed scopes of works shall be provided to the Certifying Authority prior to engagement. Council reserves the right to not accept any sub-contractor working on a site based on previous poor compliance with Council's requirements. Sub-contractors may also be suppliers of materials to be incorporated into the works. Sub-contractors who supply materials for the works may also be referred to in this Guideline as "Suppliers".

Suitably Qualified Person - A person that holds such qualifications approved by Council's Representative.

Surveyor - A registered Land Surveyor as defined in the *NSW Surveying and Spatial Information Act 2002* and/or an Engineering Surveyor qualified to carry out civil works surveying projects.

Survey Mark - A mark placed by a surveyor as a control point, generally against AHD.

SWMS - Safe Work Method Statement.

Temporary Restoration - Restoration in accordance with Council's Engineering Guideline is applied to roads or paths following completion of a road opening activity or trenching. Temporary restorations must always be safe and trafficable until permanent restorations are carried out.

TGS - Traffic Guidance Scheme.

TMP - Traffic Management Plan.

Traffic Controller - Suitably qualified in accordance with the TfNSW Guide for Traffic Control.

Unauthorised Works - Works that are carried out without a permit or approval from Council.

Utility Authority - National or state roads authority, municipality, other body or individual responsible for the care, control and maintenance of utility infrastructure.

Utility Services - Public infrastructure services including water, sewerage, drainage, gas, electricity, telephone, telecommunication or other like service.

Vehicle Access Crossing - Part of an access to or from a road, which crosses a footway, verge or other road related area and connects a road to an adjoining driveway within adjacent land.

Verge - Area between the carriageway and the property line. It allows provision for services, footpaths shared paths, cycle paths, street trees and street furniture.

WAD - Works Authorisation Deed issued by TfNSW on their road network.

WAE - Work-As-Executed drawings.

WHS Act - *Work Health and Safety Act 2011*.

Works - All works required to complete the project as specified and approved.

Works Within Road Reserve Permit - A permit issued under Section 138 of the *Roads Act 1993* by Council.

WSAA - Water Services Association of Australia.

3 General Matters

3.1 General

The Engineering Guideline has been compiled to outline Council's general procedures and practices in respect of design and construction requirements for future public infrastructure assets and various private site works in the Hilltops Council Local Government Area (LGA).

This Design Guideline has been prepared to assist Service Providers, by informing them of Council's requirements with respect to the design and construction of assets, which will eventually be vested in and maintained by Council and to ensure that such works are provided to appropriate and sustainable standards, ensuring that the principles of ecologically sustainable development are appropriately considered in accordance with the Local Government Act 1993.

3.2 Reference Documents

Reference documents include but are not limited to:

- Austroads publications for which there is a specific Glossary of Terms publication and incorporate some definitions in individual documents.
- Transport for NSW (TfNSW) or documents which incorporate definitions.
- Australian Standards documents for which there is a specific Glossary of Terms, such as AS 1348 Road and Traffic Engineering and incorporated definitions in individual documents.
- Engineers Australia publications.
- Water Services Association of Australia documents relating to supply of water and sewerage services and their respective supplements.
- Australian Rainfall and Runoff.
- IPWEA.
- Hilltops Council LEP and DCP.
- Hilltops Council Active Transport Plan 2025.
- Water Directorate of NSW Publications NSW
- TfNSW NSW Speed Zoning Standard (Current)
- TfNSW DORAS (Design of Roads and Streets Manual) (TS 00066)
- TfNSW Kerbside Electric Vehicle Charging

In any instance, where because of terminology, the interpretation of this Design Guideline is in dispute, definitions shall be clarified by Council's Representative.

In NSW there is a hierarchy of legislation which governs the development process. There are numerous Local, State, Federal government requirements along with industry standards that are required to be satisfied before building or development can commence.

When considering development work it is important to determine which category of development is applicable. Development rules are hierarchical with Acts and Regulations sitting at the top and providing legality to other rules.

Directly underneath is State Environmental Planning Policies (SEPPs) which guide development and building across NSW. Council develops Local Environmental Plans (LEPs) which are legislation made by the Minister of Planning.

To support legislation and provide guidance at a local level Council, through a legal process, makes Contribution Drawings, Development Control Plans (DCPs), policies and other documents.

The hierarchy of these documents, in the context of the drawing documents is outlined below:

1. Statutory Drawing Instruments, including but not limited to Acts, Regulations and the SEPP.
2. Local Environmental Plans.
3. Development Control Plans.
4. Engineering Guidelines for Subdivisions and Developments.
5. Contribution plans.

3.2.1 Local Environmental Plans

There is a single LEP for Hilltops Council in force:

- Hilltops Local Environmental Plan 2022

Additionally, there are three Historical LEPs:

- Young Local Environmental Drawing 2010
- Boorowa Local Environmental Drawing 2012
- Harden Environmental Drawing 2011

All LEPs can be found on the NSW Legislation website

3.2.2 Development Control Plans

DCPs further the objectives of the LEP by providing detailed land use requirements and guidelines and spell out where different types of development may be permitted.

The LEP does not normally provide detailed guidance regarding specific development design and location. Generally, the purpose of a DCPs is to indicate to anyone who seeks to develop what level of detail is required with certain types of applications and what standards are sought with the design of certain developments.

DCPs contain more detailed controls with regards to specific development types and locations. They provide additional guidance and controls about different types of development and land uses. A DCP is prepared and adopted by Council.

There is a single DCP currently in place:

- HILLTOPS DEVELOPMENT CONTROL PLAN 2025

There are two former DCPs;

- Former Boorowa Council area
- Former Young Council area.

3.2.3 Contributions Plans

Contribution Plans are prepared by Council under the *Environmental Planning and Assessment Act 1979* (EP&A Act) to help fund the local infrastructure required to support new development. For example, roads, traffic management works, open space, and community facilities. Only one type of contribution (either 7.11 or 7.12) can apply to a development, never both.

- Section 7.11 Contributions (formerly Section 94): Applied where a development creates a quantifiable demand for new or upgraded infrastructure. Hilltops currently have the following 7.11 plan in force:
 - HILLTOPS HEAVY HAULAGE CONTRIBUTIONS PLAN 2024 - Developments generating heavy vehicle traffic to contribute towards road maintenance and upgrades.
- Section 7.12 Levies (formerly Section 94A): Applied where the impacts of development are more general and not readily quantified. These are set under separate adopted plans for each of the former local government areas:
 - Young Section 94A Development Contributions Plan
 - Harden Section 94A Development Contributions Plan
 - Boorowa Section 94A Development Contributions Plan (2014)

Each plan identifies how levies are calculated and the types of public facilities they fund. Development consents in the relevant former local government area will be subject to the requirements of the applicable plan.

Local Government Act 1993 (Section 64 – Developer Servicing Plans):

- Council also levies developer charges for water supply and sewerage infrastructure under Section 64 of the *Local Government Act 1993*, enabled by the *Water Management Act 2000*. These charges are defined in the relevant Developer Servicing Plans (DSPs) for each former Council area, including:
 - Young Water & Sewer DSP
 - Boorowa Sewer DSP
 - Boorowa Water DSP

These DSPs ensure that new development contributes fairly to the cost of headworks and system augmentations needed to service growth, while local reticulation within subdivisions remains the responsibility of the developer.

Together, the contribution plans (s7.11 and s7.12) and the servicing plans (s64 DSPs) provide the framework to ensure that the costs of new infrastructure are shared equitably and that existing communities are not unfairly burdened by development.

3.3 Conflicting Standards and Guidelines

The provisions of Council's Design Specification apply to all works within the Hilltops Council LGA, but do not override any conflicting provisions of other Parts of Council's Development Control Plan or any consent issued applying to a particular development.

This Design Guideline is intended to highlight the specific requirements of Hilltops Council, with respect to the requirements of other Councils, Australia/New Zealand Standards and other industry standards, i.e. differences, additions and omissions. Where there is a conflict

or ambiguity between a requirement of Council's design Specification and that of a referenced document, then the requirements of this Design Guideline shall take precedence over those in the referenced documents in so far as resolution of the point of conflict is concerned.

Where this Design Guideline refers to an Australian Standard, Australian/New Zealand Standard, Austroads or TfNSW publication or other document that has been superseded by a new or updated version, which was issued after commencement of the works, then Council's Representative shall be consulted as soon as possible to determine which requirements shall apply.

In all cases, the Service Provider shall adequately inform Council's Representative of any potential and actual conflicts as soon as they become aware to allow Council the maximum time available to resolve the conflict. The Service Provider shall provide all necessary information to adequately inform Council's Representative of any associated and consequential impacts on design or construction prior to the contract commencing. Council's Policies and Procedures take precedence for all Hilltops Council employees.

As part of the DA assessment process, it is the responsibility of the applicant and their consultants to demonstrate due diligence in confirming that all referenced specifications and standards are the most current available at the time of lodgement. If, during Council's evaluation of the development application, it is identified that outdated specifications have been relied upon, Council reserves the right to require the submission of revised and updated plans, reports or supporting documentation prior to determination. Any delays associated with this requirement will be the responsibility of the applicant.

3.4 Departure from the Specification

Consideration may be given for products or work methods which do not strictly comply with Hilltops Council's Engineering Guideline. Details of the proposed departure from the Specification need to be submitted to Council's Representative for consideration and potential approval.

3.5 Council's Standard Drawings

Standard Drawings referred to in this Design Guideline can be found in 'Council's Engineering Guideline Design - Standard Drawings' and are available to download from Hilltops Council's website and will be updated from time to time when required.

3.6 Lapsing of Approvals and Certificates

Council's Specification requirements shall be those current at the time of issuing of the Subdivision Works Certificate (SWC) and or Civil Works Approval.

A SWC and or Civil Works Approval for subdivision works and/or development related works shall lapse with the Development Consent, or in the instance of a Development Consent that has commenced, the approval shall be limited to a maximum of five (5) years from the date of the Development approval. A Development Consent for a subdivision involving subdivision works or other Development involving civil works will normally lapse after a set time following the issue of the Development Consent. In this event, should a new Development Consent be obtained, a submission of updated engineering plans will be required for a new SWC and/or Civil Works Approval related to the new consent.

A Civil Works Approval for civil engineering works associated with a Building Development shall lapse with the Development Consent, or in the instance of a Development Consent that

has commenced, the approval shall be limited to a maximum of five (5) years from the date of the plan approval.

Substantive commencement of works is defined as construction work relating to the development is physically commenced on the land to which the consent applies before the date on which the consent would otherwise lapse under this section. Section 96 of the Environmental Planning and Assessment Regulation 2021 states for those developments determined after the 15 May 2020, certain activities are now excluded to meet this requirement. These activities include:

- Creating boreholes for site soil testing
- Removal of soil or water for testing
- Conducting survey work, including peg placement/set out for construction or boundary definition
- Acoustic testing
- Vegetation removal as an ancillary task

3.7 Project Personnel

The Service Provider shall nominate to Council the persons who will hold key roles for the works. These key roles may include the Project Manager, Accredited Certifier, Engineering Designers, Registered Surveyors, the Geotechnical Consultant and others as directed by Council.

3.8 Limitations on Accredited Certifiers

Accredited Certifiers when appointed by a Service Provider operate under Part 6 of the *Environmental Planning and Assessment Act 1979*. Accredited Certifiers may not certify design plans/ drawings in respect of works which the Council needs to approve under alternative legislation, even though those works are required by a condition of a Development Consent under the *Environmental Planning and Assessment Act 1979*.

These works include:

- Water and sewer works or works which affect water and sewer works pursuant to Section 306 of the Water Management Act 2000.
- Works on public roads requiring an approval under the *Roads Act 1993*.
- Drainage works requiring an approval under the *Local Government Act 1993*.
- Works where the Local Environmental Plan (LEP) may preclude an Accredited Certifier from being appointed.

Further approvals may be required on Classified Roads where TfNSW is the approval authority.

Compliance Certificates for Development Consent conditions involving such approvals can only be issued by Council once Council is satisfied the condition has been complied with.

Persons accredited or acting under the *Environmental Planning and Assessment Act 1979* as private Accredited Certifiers are specifically excluded from varying the requirements of Council's Design Guideline Specification in any way.

3.9 Works Subject to Approvals by Other Authorities

Where conditions have been imposed under an integrated approval or where the Service Provider is required by legislation to obtain approval from others the following applies:

- The design and construction of works shall be carried out to meet those Authorities' specifications in addition to those of Council.
- The Service Provider is responsible for obtaining any permits and licences, achieving required inspection and works standards and gaining final approval of relevant Approval Authorities.
- Copies of approvals, permits and licences to be obtained from Approval Authorities by the Service Provider shall be provided to Council prior to commencement of site activities.
- Copies of final approvals of works and documentation verifying compliance with the requirements of Approval Bodies shall be provided to Council by the Service Provider before completion can be agreed to and accepted by Council.

3.10 Crown Roads

Crown Roads are public roads administered by the NSW Department of Planning and Environment – Crown Lands Division under the *Roads Act 1993*.

They remain the property of the State until formally transferred to Council under Part 10, Division 1/1A of the *Roads Act 1993* and are not maintained by Council unless such transfer has occurred.

To ensure all works, drainage outlets, or access connections involving Crown Roads comply with State legislation and the Administration of Crown Roads Guideline (Department of Industry – Lands & Water, 2018) the following requirements are to be noted.

- Consent and Approvals
 - Any proposal for works, road formation, or drainage discharge within or adjoining a Crown Road requires written consent from Crown Lands NSW as the relevant Roads Authority (under s.71 or s.138 of the *Roads Act 1993*).
 - Where development relies on a Crown Road for access, legal access and ownership must be resolved before a Construction Certificate is issued.
 - A Review of Environmental Factors (REF) may be required under Part 5 of the *Environmental Planning and Assessment Act 1979*.
- Transfer to Council

See Councils Adopted Policy for the Transfer of Crown Roads to Council on Councils website for further details.
- Closure or Sale
 - Closure or purchase of a Crown Road is administered under Sections 37 or 152B of the *Roads Act 1993* and the *Crown Land Management Act 2016*.
 - Legal access to affected properties must be retained via alternative easements or new road openings.
- Drainage and Utility Services

- Drainage discharge or utility installation within Crown Road reserves requires Crown Lands' concurrence and compliance with waterway and environmental protection standards.

3.11 Classified Roads and Applicable Standards

Transport for NSW (TfNSW) control works on Classified Roads under the Roads Act 1993. Classified Roads include those with a legal class of highway, main road, secondary road, tourist road or transitway. Council controls works on Classified Regional Roads. Refer to Schedule of Classified Roads and Unclassified Regional Roads on the Transport for NSW website.

To manage the extensive network of roads for which Council is responsible under the *Roads Act 1993*, TfNSW in partnership with local government established an administrative framework of State, Regional, and Local Road categories. State Roads are managed and financed by TfNSW and Regional and Local roads are managed and financed by Councils.

Designers shall obtain from TfNSW the current design and project requirements applicable to classified roads.

Designers shall contact TfNSW at the beginning of the design process to clarify administration processes for design and works agreements (Works Authorisation Deeds).

TfNSW have adopted the Austroads Guides and Australian Standards as their primary technical references related to road design. However, it must be noted that TfNSW has issued Supplements to clarify, add to, or modify these documents.

3.12 Constructability, Health and Safety in Design

Designers shall comply with the *SafeWork NSW requirements for Health and Safety in Design - CHAIR - Safety in Design Tool*.

CHAIR (Construction Hazard Assessment Implication Review) is a tool to assist designers, constructors, clients and other key stakeholders to come together to reduce construction, ongoing operation, maintenance, repair and demolition safety risks associated with design.

The Australian Council of Building Design Professions (BDP) and the Royal Australian Institute of Architects (RAIA) support the use of CHAIR. The BDP believes that along with the quality and amenity of the built environment, its safety is also determined at the design stage. "CHAIR is a tool that will enable better safety awareness and solutions for improving safety and construction through identifying potential hazards by a co-ordinated approach by all stakeholders".

4 Safe System Approach

All elements of the road and street network shall be designed to align with Safe System approach and the associated boundary conditions. Safe System boundary conditions for key conflict types are as follows:

- 30km/h in locations where conflicts between vulnerable road users and vehicles are possible.
- 50km/h at intersections where side impacts between vehicles are possible.
- >70km/h on roads where there is no possibility of side or frontal (head-on) impacts.

Figure 1 below shows the survivability thresholds at the various travel speeds.

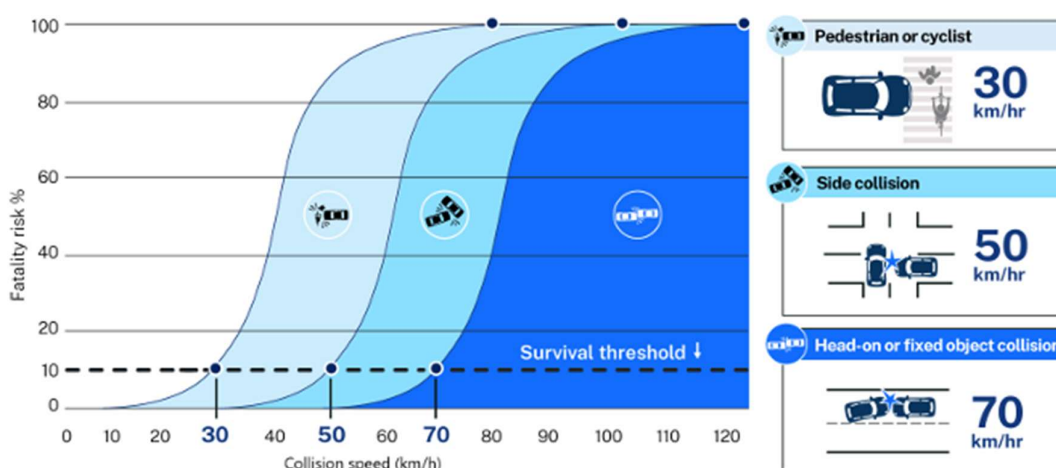


Figure 1: Survival Threshold for Different Crash Types (Source: adapted from TfNSW's Design of Roads and Streets Manual - October 2024 TS 00066:1.0)

Designers should refer to the Austroads Guide to Road Safety publications for further information and guidance on the Safe System approach.

4.1 Road Safety Audits

Road Safety Audits and or Road Safety Checks shall be conducted in accordance with the TfNSW Guidelines for Road Safety Audit Practices 2011 by auditors who are registered on the Register of Road Safety Auditors administered by Transport for NSW. This is a minimum of one Level 3 (Lead) Auditor and one Level 2 (Senior) Auditor as the minimum team for a Road Safety Audit. A minimum one Level 3 (Lead) Auditor will be required for a Road Safety Check.

Generally, the requirement for an Audit or a Check will be identified by a consent condition and will be based on the type, value, scale and complexity of the proposal. However, if the project relates to a proposal that is not subject to a consent condition such as a Master Plan, a Rezoning, or where the consent is silent regarding the requirement, the intervention levels in Table 1 shall apply.

Road Safety Audits and/or Road Safety Checks may also be required for minor works or developments where increased risk has occurred, for example, where a bus stop is relocated that will influence bus users to crossroads at a different location, or where a construction access may increase traffic volume and traffic type at a school zone. Refer to Note 11 of Table 1.

These intervention levels are minimum intervention levels and do not preclude Council or TfNSW from carrying out inspections at any time. The Service Provider may elect to arrange a concept Road Safety Audit to provide greater confidence prior to the commencement of a detailed design.

Table 1: Road Safety Audit and Road Safety Check Intervention Levels

Development / Work Type	Total Project Cost ¹	Road Safety Audit (RSA) ² or Road Safety Check (RSC) ³			
		Concept Design	Detail Design	Roadworks ⁴	Pre-Open / Finish
Subdivision with new roads	≤\$500,000		RSA		RSC
Subdivision with new roads	>\$500,000		RSA		RSA
Intersection	≤\$300,000		RSA		RSC
Intersection	>\$300,000 up to \$4million		RSA	RSC	RSA
Intersection	>\$4million	RSA	RSA	RSA	RSA
Major Road Works	≤\$750,000		RSA		RSC
Major Road Works	>\$750,000		RSA	RSC	RSA
Traffic Control Facility ⁵	≤\$50,000		RSC		
Traffic Control Facility ⁶	>\$50,000 ⁷		RSC		
Shared Path systems	≤\$100,000		RSC		RSC
Shared Path systems	>\$100,000		RSA ⁸		RSA ⁹

¹ Excluding Council fees and contributions and consulting fees. Project values shall be indexed in accordance with CPI amounts.

² As defined by Austroads

³ As defined by the TfNSW Guidelines for Road Safety Audit Practices

⁴ These are in addition to any WHS routine checks. These are in addition to any Work Health and Safety routine checks.

⁵ As defined by the Transport Administration Act 1988.

⁶ As defined by the Transport Administration Act 1988.

⁷ Where value exceeds \$500,000 apply same requirement as intersection.

⁸ Either a Detail Design or a Pre - Opening Audit is required, not both.

⁹ Either a Detail Design or a Pre - Opening Audit is required, not both.

Development / Work Type	Total Project Cost ¹	Road Safety Audit (RSA) ² or Road Safety Check (RSC) ³		
		Concept Design	Detail Design	Roadworks ⁴ Pre-Open / Finish
Development Access			RSC	RSC
Developments ¹⁰			RSA	RSA
Rezoning/Master Drawing, etc		RSA		
Minor Works		Refer to Note 11 ¹¹ Below		

4.2 Bushfire Prone Areas (BPA's)

In carrying out the design and construction of the works, designers shall ensure that bushfire protection measures required by conditions of consent, other approvals or other Authorities' requirements are incorporated into design plans and specifications. Designers must also ensure that all works do not create previously unidentified bushfire protection issues. This may include the impact of fully established landscaping on fire protection measures.

Designers shall reference relevant current documents published by the NSW Rural Fire service, current Australian Standards and the Building Code of Australia when designing for provisions related to bushfire protection.

4.3 Design in Flood Affected Area

Reference shall be made to Council's adopted Flood Risk Management Plans and any available flood studies when carrying out design in areas that are, or may be, flood affected.

Filling of floodplains and floodway is not permitted.

Flood Planning Levels (FPL), flood levels or minimum floor levels, including appropriate allowances for climate change, are to be interpreted from Council's Floodplain Risk Management Plans, adopted flood studies, or related technical investigations.

Where reliable flood information is available from Council's records or existing studies, this information shall be used for design purposes.

Where no suitable or reliable flood information exists, or where Council's records indicate flood controls but do not provide sufficient detail, the Service Provider must commission a flood study. Such study shall:

- Be prepared and certified by a qualified engineer experienced in flood modelling.
- Be provided to Council for review and acceptance; and

¹⁰ Inclusive of tourist, shopping/commercial or industrial, master planning, educational/sporting and recreational facilities, places of worship, hospitals, service stations or other developments depending on traffic generation and/or development layout.

¹¹ Minor works that involve increasing vehicle/vehicle conflict, pedestrian/vehicle conflict, new accesses (temporary or permanent), changes to public transport, loading or delivery areas, etc that increase crash risk will require either a Road Safety Audit(s) or a Road Safety Check.

- Be consistent with the following documents:
 - The Institution of Engineers, Australia – Australian Rainfall and Runoff: A Guide to Flood Estimation, latest edition.
 - NSW Land and Property Information / LPMA Standard LiDAR Product Specifications (Including RCD105 Specification Imagery) Version 2.0, July 2010 (or subsequent standards as issued).

All flood model results shall be supplied to Council in a GIS-compatible format suitable for use with ESRI software and in accordance with Council's Spatial Data Standards.

4.4 Format for Designs

- The detailed designs are to be provided in both pdf and unlocked CAD 2018 formats
- The designs must be in georeferenced in GDA co-ordinate system GDA 20, Zone 55
- Levels must be noted in Australian Height Datum (AHD)

5 Applications for Works Approval

5.1 General

A Construction Certificate must be obtained prior to commencement of any site establishment and construction works to which a Development Consent relates. The Construction Certificate normally relates to works only within the properties to which the Development Consent relates.

A Subdivision Works Certificate is a specific type of Construction Certificate in that again must be obtained prior to commencement of any site civil establishment and construction works to which relates to a Subdivision Development Consent. This may involve but not limited to road, water mains, sewer extension and stormwater works.

A Works Within Road Reserve approval must be obtained prior to commencement of any site establishment and construction works in relation to works where the approval of those works is required under the Roads Act 1993 or the Local Government Act 1993 or the Water Management Act 2000. This approval is required in addition to any Construction or Subdivision Works Certificate in a separate application.

A Section 68 approval must be obtained for civil related works relating to construction works requiring additions to the existing Council Stormwater, Water main or Sewer systems in the road reserve or reserve. These are required primarily in conjunction to the issue of a Construction Certificate.

In addition to the preparation of engineering plans and specifications, the issuing of a Subdivision Works Certificate, Works in Road Reserve or Section 68 Approvals may involve compliance with a range of matters which may include:

- Development Consent conditions.
- Integrated Development Approval requirements.
- Utility suppliers' information and requirements.
- Section 68 Approvals involving water and or sewer connections.
- Affected landowner requirements.

Applications to Council for Subdivision Works Certificates and Section 68 Certificates involving civil works shall be made via the NSW Planning Portal.

For Works within Road Reserve Approval shall be made using the appropriate application forms which may be obtained from Council's web site (<http://www.hilltops.nsw.gov.au>). Application forms shall be accompanied by all documentation relevant to the application.

A Compliance Certificate for Complying Civil Works is only issued by Council where Council has been engaged to carry out compliance inspections as the Certifying Authority.

5.2 Consultation with Council

It is recommended that the Service Provider and their Design Consultant meet with Council prior to commencement of the design process to gain an understanding of critical aspects of the Development Consent and the approval processes relevant to the design.

5.3 Development Consent

The Development Consent may require:

- Obtaining approvals from other authorities.
- Obtaining further approvals from Council regarding aspects of the development.

It is the responsibility of the Project Manager to make enquiries and meet any additional requirements to enable the detailing of drawings and preparation of specifications as required for such matters as:

- Integration of environmental and professional report information.
- Integrating requirements of other Council approvals.
- Location, protection or relocation of utility mains and Installations.
- Provision of utilities and street lighting.
- Approval body compliance.
- Affected private landowner agreement.

Council may require copies of appropriate documentation for any consent, licence, permit, permission or any form of authorisation prior to the issuing of a Construction Certificate or Civil Works Approval.

5.4 Preparation of Engineering Design Submission to Council

Plans and documentation which accompany an application for Civil Development and Subdivision Works shall be prepared in accordance with Council's Engineering design guideline, specifications and the Development Consent.

Design plans and documentation are also to serve as the reference plans for detailing other site activities or controls required by conditions of the Development Consent, for example, wildlife and heritage protection. Where supplementary plans, documentation or studies are required to appropriately detail other site activities or controls, notes shall be included on the appropriate design base plans referencing the supplementary requirements.

It is necessary that engineering plans for civil works incorporate all necessary details for all approved development activities. It may not be sufficient to reference environmental or other reports without incorporating relevant report recommendations into the design. Please also refer to Appendix A: Preparation and Presentation of Design Drawings

5.5 Submission of Preliminary Engineering Plans to Council

A preliminary set of plans and supporting information may be submitted for examination with a view to resolving technical issues. Subsequent submissions shall comprise of a full application for a Subdivision Works Certificate and/or Works within Road Reserve Approval, a Compliance Certificate or other required approval.

Fees will be applicable for preliminary reviews and resolving technical or other design related issues in accordance with Council's adopted fees and charges.

5.6 Other Approval Applications Required by Council

A range of applications to Council may be required where Council is responsible for approvals outside the *Environmental Planning and Assessment Act 1979* or where Council-controlled land is affected.

These approvals may include:

- Local Approvals under the *Local Government Act 1993*.
- Water and Sewer connections or adjustments.
- Section 306 Certificate of Compliance Notice of requirements (*Water Management Act 2000*).
- Application for Approval of Engineering Plans and Specifications for Water and Sewer works under Section 306(2) (b) the *Water Management Act 2000*.
- Applications for Approval under Sections including 74, 75, 115, 122, 138 and 139 of the Roads Act 1993 to do work or control traffic on a Public Road.
- Works on Council controlled land.
- Applications for Approval under Section 68 of the *Local Government Act 1993* to carry out water, sewerage and stormwater works, or swing/hoist items over a public road.
- Works on Council-controlled land.
- Approvals under current road transport / traffic management legislation, as required, including any approvals for traffic control devices or road-related works under the relevant Acts or Regulations

The requirement to make these applications will usually be contained in the Development Consent conditions. However, the requirement for these applications may not be evident until assessment of Civil Works designs or the commencement of construction.

5.7 Other Issues Relating to Development Consent

Applicants are responsible for giving adequate lead time for consideration of an application by Council and any other Authority where applicable.

Construction works cannot commence until a Subdivision Works Certificate and/or a Works within Road Reserve Approval is issued, and any other required approval has been obtained.

It must be noted that legislation stipulates that a Subdivision Works Certificate has no effect and may not be issued retrospectively for works already carried out.

5.8 Application to Modify Works Approval

An application may be made for modification of a Subdivision Works Certificate as permitted by Regulation clause 148(1) of the Environmental Planning and Assessment Regulation 2000.

This application may be made by the applicant for the original Subdivision Works Certificate or a person having the benefit of the Subdivision Works Certificate.

An application may also be made for modification of a Civil Works Approval.

5.9 Works Undertaken by Council

Generally, road and drainage upgrade works undertaken by Council or its Contractors in road and drainage reserves do not require Development Consent under Part 4 of the *Environmental Planning and Assessment Act 1979*.

An environmental assessment shall be prepared by the Service Provider or Council's Representative for proposed upgrade works under Part 5 of the *Environmental Planning and*

Assessment Act 1979, in accordance with Council's Environmental Management System, taking into consideration the provisions of the State Environmental Planning Policy (Transport and Infrastructure) 2021 and other applicable internal environmental, waste and stockpile management guidelines. The environmental assessment shall be approved by a delegated officer, prior to commencement of construction works.

6 Site Earthworks Design

6.1 General

Provisions of Council's Engineering Guideline - Construction Specification and other Council references apply to subdivision development site works involving earthworks or earthen structures as well as other development related works on land under Council's control.

Requirements from any management plans related to the development approval or required by the development approval conditions shall be incorporated in the design of earthworks.

The Developer is to ensure that necessary environmental licences pertaining to site earthworks are obtained and their requirements are incorporated in the engineering design and any supplementary Specification.

The Designer shall consider as a minimum those factors that may affect the earthworks listed in Section 2 of AS 3798 Guidelines on earthworks for commercial and residential developments, for all types of development.

A Geotechnical Consultant shall be engaged by the Developer to carry out site investigation and provide site specific recommendations regarding earthworks design and construction.

6.2 Expansive and Reactive Soils

The retention and use of expansive and reactive soils shall be in accordance with the recommendations of a Geotechnical Engineer's report obtained in respect of the impact of any reactive soils on the following:

- Design of road pavements.
- Design of public infrastructure.
- Suitability for building foundations.
- Design of thrust restraint

6.3 Urban Salinity

The Designer shall seek specialist advice regarding designing for urban salinity where it has been identified as an issue during the development assessment process or where the site investigation by the Geotechnical Consultant identifies urban salinity as an issue.

The Designer shall provide measures and specifications to:

- Prevent any impacts of salinity on proposed infrastructure.
- Mitigate the impacts of salinity on proposed private land.
- Prevent any immediate or progressive increase in severity or coverage of areas affected by salinity.

6.4 Minimisation of Soil Surplus

The designer shall endeavour to minimise the amount of surplus material that will be required to be removed from the site. Factors that must be considered in relation to surplus material include the cost to remove and dispose of material to an approved waste facility, classification of the material and reuse of the material at an alternate approved site if allowed by the materials waste classification.

6.5 Site/Lot Regrading

Site regrading may only be carried out as identified in the Development Consent.

Lot grading shall provide safe, stable and usable building platforms, ensure effective drainage, and minimise excessive cut and fill.

Grading is to complement the natural landform while achieving satisfactory overland flow paths and minimising erosion and instability.

The designer shall consider the following points as part of the design:

- Any requirements arising from the Development Consent conditions such as Stormwater Management Plan and a Vegetation Management or Tree Protection Plan.
- Cut and filled areas are generally to be shaped and graded at a minimum of 1% to avoid surface pondage and facilitate drainage.
- The fall of the regraded surface shall direct surface flow to generally retain existing runoff conditions beyond the regrade area other than where being collected and conveyed by a designed drainage system such as a roadway. Surface runoff from regrade areas is not to be directed into existing inter-allotment drainage systems. Provision shall be made along the toe of the fill batters or base of retaining walls within or adjacent to regrade areas to permit the free passage of stormwater and subsurface water away from adjoining properties.
- Regrading or retaining works at property boundaries are not to cause surface ponding or the reduction in stormwater disbursement from adjoining properties or impact on the amenity of such properties. Catch drains, sub-surface drains and/or inter-allotment drainage shall be provided to adequately drain such areas. The drainage system shall be designed and have a capacity to ensure that there is no risk to persons, inundation of habitable property or potential for drainage nuisance due to flooding.
- Where slopes exceed four horizontal to one vertical (4:1), geotechnical advice shall be obtained in respect of groundwater flows and slope stability issues in areas affected by regrading. For council reserve areas, six horizontal to one vertical (6:1) shall be provided.
- The design of works within areas affected by regrading must consider the proposed finished surface levels in addition to the existing surface levels. (Refer to **Error! Reference source not found.**).

Building pads shall be designed so that the finished surface gradients and supporting structures comply with the following design parameters:

Table 2: Design Parameters

Design Element	Requirement / Control
Maximum lot gradient	5 % (1 in 20) in any direction. Grades greater than 5 % are not permitted and require retaining structures.
Retaining walls (standard)	< 1.0 m high per wall, with ≥ 1.0 m horizontal setback between successive walls. Refer also to Hilltops DCP.

Design Element	Requirement / Control
Retaining walls (engineered)	Where compliant grading cannot be achieved with walls < 1.0 m, provide structural retaining wall design certified by a qualified Structural Engineer (AS 4678 / AS 3600 / AS 3700). Refer also to Hilltops DCP.
Cut / fill limit (unretained)	≤ 1.0 m ; deeper excavation or fill must be retained by a certified structure.
Boundary setbacks	Outer wall face on boundary and wall is a shared boundary wall registered under the Section 88B instrument for the subdivision.
Finished floor freeboard	≥ 300 mm above adjacent overland flow path or surface drain.

Additional requirements:

- Earth batters are not permitted to achieve compliant lot grades.
- Retaining structures shall incorporate subsoil drainage and discharge to approved outlets.
- Interallotment boundary retaining walls that form part of the subdivision design shall be constructed with the outer face on the common boundary and registered on title under the Section 88B instrument, clearly allocating ownership and ongoing maintenance responsibility to the respective lot owners.
- Boundary retaining walls facing road reserve will be subject to ensuring zone of influence does not enter the road reserve as determined by geotechnical engineer.
- Engineered retaining solution submitted prior to approval.
- Surface runoff from each lot shall be directed to the approved inter-allotment or street drainage system, with overland flow contained within the lot boundaries and designed for the 1 % AEP event.
- All earthworks shall comply with AS 3798 – Guidelines on Earthworks for Commercial and Residential Developments.
- Subdivision layouts must demonstrate that compliant pad grades can be achieved prior to approval of engineering drawings.

Where compliant grading cannot be achieved without excessive cut or fill, the layout shall be redesigned or supported by an engineered retaining solution prior to approval.

Erosion and sediment controls shall be implemented in accordance with Managing Urban Stormwater: Soils and Construction (Landcom, 2004).

6.6 Retaining Walls and Batters

The location of retaining walls or batters will depend on:

- The type and design of the wall or batter including surface and subsurface drainage and backfill material.
- Foundation requirements.
- The construction method with provision for support throughout construction activities.
- Locations of existing and proposed services including inter-allotment drainage and sewers.
- Locations of existing and proposed drainage secondary flow paths.
- Measures and works designs required for the protection and support of services throughout construction activities and in a permanent manner.
- Any structures on the properties adjacent to a proposed excavation.
- Vegetation to be retained.
- Permit to Enter or impacts on adjoining land or structures.
- The impact on existing drainage overland flow paths.
- Achieving the required sight distance where the retaining wall is located adjacent to a road.
- The location of existing or proposed sewer or water main.

All retaining walls and batters must be consistent in height and extent as approved in the Development Consent. Road batters shall be blended into adjacent proposed lots where possible. Retaining walls, including the footings, footing support and batters, other than road batters, shall be wholly located within the lot required to provide support (Note: The common law duty of care for negligence regarding support for land is contained in Section 177 of the *Conveyancing Act 1919*).

The Applicant shall arrange for the retaining wall to be designed and certified by Suitably Qualified Engineer. The design shall, as a minimum design standard, be carried out in accordance with AS 4678:2002 – Earth-retaining structures and Section 9 Design of structures of this design guide. The absolute minimum design life shall be 60 years. Where access to the proposed retaining wall will not be practicable in the future for its reconstruction or replacement the design life must be increased to 100 years.

The design of batters shall be carried out using recommendations made by a Geotechnical Engineer who shall identify any constraints on the use of adjoining areas of land and any ongoing maintenance requirements for batters. Batters shall not impose or create onerous constraints and maintenance requirements.

The desirable gradient of batters within lots shall be 6:1, with a maximum design gradient of 4:1 in exemptional circumstances like rock and only where written advice is provided by a geotechnical Engineer, which supports steeper batters.

6.7 Acoustic or Landscaped Mounds

Acoustic or landscaped mounds shall be provided in accordance with the approved drawings and or Engineering Report.

Attention shall be given to provision for surface drainage flows around mounds in particular the consequences of concentration and diversion of runoff. The final grade of the acoustic or landscaped mounds shall take into consideration the need for workers to safely undertake maintenance activities.

A grade of 6:1 is generally considered acceptable for maintenance worker safety where mowing activity is required to regularly maintain the batter.

6.8 Site Classification in Accordance with AS2870

Preliminary residential lot "Site Classifications" in accordance with AS2870 Residential slabs and footings based on anticipated site conditions shall be provided as part of the Geotechnical Engineer's site investigation report. This report shall be provided as supporting information for the earthworks design.

Final residential lot "Site Classifications" in accordance with AS2870, which may be used for footing design purposes, shall be provided to Council prior to the issue of a Subdivision Certificate.

The Lot "Site Classification" report (preliminary and final) shall be prepared by a Qualified Practising Geotechnical Engineer.

6.9 Effects on Utility Services

The Designer is to identify all services that are impacted by proposed earthworks. Refer also to Section 15 Utility Services Design and Installation of this Design Guideline.

7 Design Requirements for Roads Civil Works

7.1 General

Detailed Design Drawings and documentation shall describe the extent of works specified in the Development Consent, contract or project plan.

The Designer is to assume that the works will include but not be limited to signs, pavement marking, street lighting, safety barriers, utilities adjustments, transitions and tie-ins to existing structurally sound road pavements, stormwater drainage, concrete footpaths, shared paths, cycleways and remedial works or reconstruction or relocation of adjacent infrastructure necessary for the safe operation and use of the new works.

Design submissions containing over 5 lots shall be accompanied by a Design Report matching Austroads Guide to Road Design Part 1: Objectives of Road Design. Shall include justification for the design parameters adopted.

All designs must be in accordance with Austroads publications, Australian/New Zealand Standards, TfNSW Supplements and this Design Guideline. Deviations from any standards shall be expressly stated in the Design Report. For classified roads, refer to 3.11 Classified Roads and Applicable Standards.

In NSW contexts, the Design of Roads and Streets (DORAS), TS 00066 shall be referenced to guide context-sensitive, movement-and-place-led design. Where DORAS provides NSW-specific interpretation or parameters for urban streets, it is to be used in preference to generic Austroads guidance and integrated with TfNSW Supplements and applicable Standards.

DORAS applies to Transport for NSW projects on state and non-state roads and provides councils with a way to reconcile NSW legislation, standards and Austroads guidance for local conditions. Where council is the road authority, adopt DORAS as guidance and document its application in the Design Report.

The design of stormwater drainage and floodways relating to road design shall be in accordance with Section 111 - Stormwater Drainage Design of this Design Guideline.

7.2 Design Requirements for Roads

7.2.1 Road Carriageway and Verge Widths

For urban street typologies, widths and cross-section elements must be checked against DORAS Section 8 (Road and Street Types) for the identified street type (e.g., Local Streets, Main Streets, Main Roads, Civic Spaces), and any context-driven trade-offs recorded in the Design Report.

Road carriageway and verge widths for new roads shall be in accordance with Table 3, Table 4 and Table 5, Road Hierarchy and Road treatment and Width Schedules.

Consideration needs to be given to future proposals and matters such as:

- Current annual daily traffic (ADT) volume and type of use.
- Proposed road works or traffic management schemes.
- Proposed zoning changes or developments.
- Alignment and condition of constructed road pavement, kerb, etc.
- Drainage (location and adequacy) and topography (for access and verges).

- On-street car parking requirements.
- Standard of geometric design.
- Location of existing and proposed services and street trees.
- Requirements of TfNSW on Classified Roads

Table 3: Road Hierarchy – Design Speed and Kerb Requirements

Function	Max. No. of Dwellings/Lots Served	Design Traffic (ESA's) with Buses and Kerb Side Waste Vehicles	Frontage Access	Design Speed Environment (km/h) ¹²	General Kerb and Gutter Requirement
Urban Residential					
Laneway.	20	6.0 x 10 ⁴	yes	20	Yes, min. one side
Cul-de-sac.	15	2.0 x 10 ⁵	Yes	40	Yes
Local Access.	15-100	6.0 x 10 ⁵	Yes	50	Yes
Collector.	100-500	2.0 x 10 ⁶	Yes	50	Yes
Sub Arterial.	500-4000	4.0 x 10 ⁶	Yes	50	Yes
Industrial					
Cul-de-sac – light industry		2.0 x 10 ⁶	Yes	40	Yes
Cul-de-sac Heavy industry		5.0 x 10 ⁶	Yes	40	Yes
Through Road Light Industry		5.0 x 10 ⁶	Yes	50	Yes
Through Road Heavy Industrial		1.0 x 10 ⁷	Yes	50	Yes

¹² Indicative operating speeds are to assist in encouraging designs that influence lower speeds in line with safe system principles.

Function	Max. No. of Dwellings/Lots Served	Design Traffic (ESA's) with Buses and Kerb Side Waste Vehicles	Frontage Access	Design Speed Environment (km/h) ¹²	General Kerb and Gutter Requirement
Rural					
Rural Collector		2.0 x 10 ⁶	Yes	80 - 100	No
Rural Local Access ¹³		3 x 10 ⁵	Yes	60 – 100	No

Source: Austroads

Note: For NSW urban contexts, confirm the selected cross-section against the DORAS Section 8 parameters for the identified street type and document any departures.

Table 4: Road Edge Treatments

Road Edge Treatment	Used For:
*1.0m wide sealed shoulder	Rural Collector roads Rural Local Access roads
*150mm High Integral Kerb and Gutter	Urban Collector roads Industrial roads
*Concrete Edge Strip	Where applicable
*Roll Kerb and Gutter	Urban Local Access roads Urban Cul-de-sacs
*Semi-Mountable Kerb	Adjacent to Medians, Traffic Islands and Roundabouts
# Sealed intersection 50 m min. length	Unsealed road to sealed road intersection interface to save edge break and provide all weather braking area on intersection approach.

Source: * Austroads; # Council

Note: For NSW urban contexts, confirm the selected cross-section against the DORAS Section 8 parameters for the identified street type and document any departures.

¹³ Rural road operating speed, road width and geometric design shall be based on Austroads Guide to Road Design, TfNSW Supplements and Rural Fire Service requirements.

Table 5: Road Hierarchy - Standard Road Widths

Class of Road	Width of Road Reserve (m)	Footway /verge Width (m)	Carriageway Width¹⁴ (m)	Traffic Lanes (m)	Parking Lanes (m)	Seal Width (m)	Formation Width min. (m)	Shoulder Width (m)
Urban								
Service Lane	6	0.5	5.0	1	0	5.5	5.5	NA
Access (Cul-de-sac) ¹⁵	21	2 x 5.0	11.0	2 x 3.0	2 x 2.5	11.0	12.0	NA
Local	21	2 x 5.0	11.0	2 x 3.0	2 x 2.5	11.0	12.0	NA
Collector	22	2 x 5.0	12.0	2 x 3.5	2 x 2.5	12.0	13.0	NA
Distributor	22 min	2 x 5.0	12.0	2 x 3.5	2 x 2.5	12.0	13.0	NA
Industrial								
Access (Cul-de-sac) – Light INDUSTRY	21	2 x 5.0	11.0	2 x 3.0	2 x 2.5	11.0	12.0	NA
Access (Cul-de-sac) Heavy industry	21	2 x 5.0	13.0	2 x 3.5	2 x 3.0	13.0	14.0	NA

14 Carriageway widths for each road type shall be based on the applicable road function and traffic volume in achieving the required road hierarchy. Urban road centre and edge line markings shall only be installed on roads $\geq 11\text{m}$ wide, unless specifically required. Traffic lane widths on higher volume collector/distributor roads (say ADT $>4,000$), which are bus routes, shall be 3.5m min, resulting in greater road reserve widths. Both bus service and school bus routes shall be defined as bus routes for road design, pavement design and road width requirements.

15 For long Cul-de-sac an emergency exit connecting to an alternative trafficable road shall be provided, this may be by way of a Right of Access

Class of Road	Width of Road Reserve (m)	Footway /verge Width (m)	Carriageway Width ¹⁴ (m)	Traffic Lanes (m)	Parking Lanes (m)	Seal Width (m)	Formation Width min. (m)	Shoulder Width (m)
Local (Through) Road Light Industry	23	2 x 5.0	13.0	2 x 3.5	2 x 3.0	13.0	14.0	NA
Local (Through) Road Heavy Industrial	23	2 x 5.0	13.0	2 x 3.5	2 x 3.0	11.0	12.5	NA
Rural¹⁶								
Access Road (Cul-de-sac)	Variable	2 x 5.0	9.0	2 x 3.5	NA	8.0	16.0	2 x 1.5
Local Access	20 min ¹⁷	2 x 5.5 min.	10.0	2 x 3.5	NA	8.0	16.0	2 x 1.5
Collector	22 min ¹⁸	2 x 6.0 min	10.0	2 x 3.5	NA	8.0	16.0	2 x 1.5
Pedestrian Facilities								
Pathway		1.5						
Cycleway		2.5						
Shared Path		3.0						

¹⁶ Not applicable to a proclaimed TfNSW Controlled Road

¹⁷ Variable due to cut and fill batter extents. The width of the road reserve may vary in excess of the widths shown in the table due to the extent of the road formation. In rural locations there should be an area of natural topography between the toe of the cut or fill batter to the proposed boundary line

¹⁸ Function of TfNSW determination. shown as a minimum guide.

Source: Austroads

Reference is also made to the Hilltops Council Active Transport Plan April 2025.

Note: For NSW urban contexts, confirm the selected cross-section against the DORAS Section 8 parameters for the identified street type and document any departures.

Consent may be granted to a subdivision of land in Zone R1 that will create one or more lots for dwelling house sites only where services are provided in accordance with the following Table 6 in which an “X” indicates that the relevant service must be available in relation to a lot of that size:

Table 6: Zone R1 Lot Size Service Provision

Urban Services	Lot Sizes				
	1,200 m ² or more but less than 1,800 m ²	1,800 m ² or more but less than 4,000 m ²	4,000 m ² or more but less than 1 ha	1 ha or more but less than 4 ha	4 ha or more
Electricity (underground)	X	X	X	X	X
Water Supply	X	X	X		
Grass table drains				X	X
Kerb and gutter	X	X	X		
Reticulated sewerage	X	X	X		
Underground storm water drainage	X	X	X		
Telecommunications	X	X	X	X	X
Gas (where available)	X	X	X	X	X

Notes:

1. **Location specific DCP** requirements take precedence over the values stated in the above table.
2. **Indicative operating speeds** are to assist in encouraging designs that influence lower speeds in line with safe system principles.
3. **Carriageway widths** for each road type shall be based on the applicable road function and traffic volume in achieving the required road hierarchy. Urban road centre and edge line markings shall only be installed on roads ≥11m wide, unless specifically required. Traffic lane widths on higher volume collector/distributor roads (say ADT >6,000), which are bus routes, shall be 3.5m min, resulting in greater road reserve widths. Both bus service and school bus routes shall be defined as bus routes for road design, pavement design and road width requirements.
4. **Verge widths** must be widened to accommodate shared paths and the widening shall be the difference in width between the shared path and a standard 1.5m minimum wide footpath.

5. **Road grades** should be arranged and designed to achieve mobility requirements, where practicable. Maximum longitudinal gradient – 15%. For local urban and rural access. For industrial areas, 10% maximum longitudinal gradient is to be applied.
6. **Shared path(s)** minimum 2.5m wide may be required on all the above road types.
7. **Design ESAs** for pavement designs shall be determined from traffic study volumes for the subject road based on a 40-year design life.
8. **Rural road operating speed, road width and geometric design** shall be based on Austroads Guide to Road Design, TfNSW Supplements and Rural Fire Service requirements

7.2.2 Road Design Speed

7.2.2.1 Road Design Speeds and Gradients for New Roads

Road design speeds and gradients for new roads shall be in accordance with relevant parts of the Austroads publications, TfNSW Supplements and the indicative operating speed, as applicable in the Road Hierarchy and Road Width Schedule provided in Table 3 to Table 6 above unless otherwise approved by Council's Representative.

For movement-and-place-led speed environments (e.g., high-activity main streets), confirm target operating speed and supporting design elements with DORAS Section 7 and the NSW Speed Zoning Standard (TS 03631).

7.2.2.2 Road Design and Operating Speeds for Existing Roads

Design and operating speeds shall be determined by recent traffic count data or in accordance with relevant parts of the Austroads publications, TfNSW Supplements and indicative operating speeds, as applicable in Table 3 Road Hierarchy and Road Width Schedule unless otherwise approved by Council's Representative.

Where there is no recent traffic speed data, an operating speed of 10km/h higher than the posted speed limit should be adopted, which represents the typical desired speed of motorists unconstrained by geometric elements or other traffic unless otherwise approved by Council's Representative.

7.2.3 Geometric Design

7.2.3.1 Geometric Design Urban Roads

Geometric design of urban roads shall be determined in accordance with Australian Standards, Austroads publications and TfNSW Supplements.

The following general Design Controls shall also be applied in the geometric design of urban roads. However, there will be situations where alternative controls may be more desirable, and these shall be discussed with Council's Representative prior to their adoption.

General Design Controls shall include but are not limited to the following:

- Roads shall be crowned in the centre of the carriageway with the control line in the middle of the carriageway. Standard 3% crossfall shall apply to straight sealed roads. Where the longitudinal gradient is less than 1% for longer than 100m, on steep road gradients and where the crossfall/ superelevation is 3%, consideration should be given to increasing the crossfall/ superelevation to 4% to assist surface drainage runoff (provided there is no superelevation transition involved).

- Unsealed roads are to have a minimum design cross fall of 4%.
- Use of superelevation, including transition curves and widening on urban and rural roads shall be in accordance with Austroads Guide to Road Design Part 3: Geometric Design unless otherwise approved by Council's Representative.
- Vertical curves in built up areas shall be designed for a minimum stopping sight distance for the nominated design speed.
- Where changes of longitudinal grade are less than 1% occur, vertical curve lengths are not required.
- Sag vertical curves in built up areas shall be of a length to provide adequate riding comfort for the design speed.
- Sight distance calculation using a driver reaction time of 2.0 seconds for design speeds $\leq 90\text{km/h}$ in accordance with TfNSW Supplement to Austroads Guide to Road Design Part 3 unless otherwise approved by Council's Representative.
- Appropriate design vehicle(s) as indicated in Austroads Design Vehicles and Turning Path Templates with appropriate buffers applied and/or as approved by Council's Representative for each specific design element, including intersections, cul-de-sacs, vehicle access crossings, car parks, traffic calming devices and vertical clearance envelopes. Practice is to use appropriate vehicle tracking software to perform vehicle swept path analyses and supplied as part of the design drawings package.
- Cross sections shall be designed (not shown as a cross section) at a maximum of 1m intervals to enable the creation of an accurate design model unless otherwise approved by Council's Representative.
- Road design chainages and set out co-ordinates shall be provided for all control lines at a maximum of 20m intervals on straights and 15m intervals on curves, all changes in directions and curve tangent points.
- Impact on existing or future flood risk. Refer to 8.1.3 Roads within Floodway
- Road geometry must be designed in conformance with the NSW Speed Zoning Standard (current version) to ensure posted speeds and design speeds are consistent with the operating environment.
- Urban verge desirable grade/crossfall is 4% toward the carriageway from boundary towards kerb top (unless local constraints dictate otherwise) to improve hydraulic performance and surface drainage robustness.

In NSW urban streets, kerb radii, lane widths and mid-block treatments shall be checked against DORAS design solutions and the relevant Section 8 street-type parameters to support self-explaining speed environments and priority for vulnerable road users (e.g., reduced kerb radii, kerb extensions, raised platforms). Record any departures in the Design Report.

7.2.3.2 Geometric Design Rural Roads

Rural roads shall be designed in accordance with Australian Standards, Austroads publications, NSW Speed Zoning Standard and TfNSW Supplements.

7.2.3.3 Roads in Bushfire Prone Areas

In Bushfire Prone Areas, the requirements of the current NSW Rural Fire Services publication, Planning for Bush Fire Protection, A Guide for Councils, Planners, Fire

Authorities and Developers shall be met in addition to any requirements for private and public roads, driveways and accesses applying from this Manual. Refer to 7.2.6.1 for guidance on long cul-de-sacs.

There may be applicable road design requirements under an issued 100B certificate relating to the development that has to be addressed in the developments design, depending on if it's located within an identified bush fire prone area.

7.2.4 Intersection Design

Intersections shall be designed in accordance with Australian Standards, Austroads publications and TfNSW Supplements.

The appropriate sight distance must be provided on all legs on intersections in accordance with Austroads Guide to Road Design Part 3: Geometric Design and Part 4A: Unsignalised and Signalised Intersections.

Non-channelised intersections such as T-intersections or crossroads shall be detailed by cross sections at a maximum 10m interval and kerb return profiles on each leg of the intersection.

The desirable kerb return radius shall be 9–12.5 m in urban residential areas (suitable for service vehicles and single unit trucks) and 12.5–15 m in industrial areas (to accommodate articulated vehicles), measured from the face of kerb. Designers must confirm adequacy by undertaking vehicle swept-path tracking in accordance with Austroads Guide to Road Design Part 4 and Part 4A, ensuring the nominated design vehicle can turn without encroaching into opposing lanes or over the kerb.

Channelised or signalised intersections shall be detailed on each leg by cross sections at 10m intervals. Traffic islands, kerb lines and medians within at least 40m of the intersection point shall be detailed by co-ordinates and design level at a maximum spacing of 5m in addition to the other geometric set out points such as tangent points and centre of circles.

At roundabouts the approach roads shall be defined by cross sections at 10m intervals up to as close as practical to the intersection. Within 50m or any additional distance necessary to accurately set out any curves in the various kerb lines, the intersection geometry shall be defined by co-ordinates and design level at a maximum spacing of 5m in addition to other geometric set out points such as:

- At all tangent points.
- For all centres of curves.
- At all drainage pits.
- At all kerb angle points.

The co-ordinates provided shall relate to appropriate control line positions and be clearly defined on the design plan. Co-ordinate values shall be expressed to 3 decimal places with reduced levels at AHD rounded off to the nearest 5mm.

Contour plans are to be provided (contoured at 100mm) to cover the whole project pavement area to confirm the road crossfall and drainage patterns. Critical areas are where flat gradients intersect drainage inlet points.

Contour plans are to be provided (contoured at 100mm) to cover the whole project pavement area to confirm the road crossfall and drainage patterns. Critical areas where flat gradients (<1%), long flow paths or where surface flow could have safety implications, such as

intersections and associated pavement areas, superelevation transition areas ETC must be provided at 1:500 scale.

Both concept and final design plans shall include a design surface contour plan as detailed above.

Grade vector sums limits are to be checked to ensure risk of vehicle roll over is mitigated.

For NSW urban settings, apply DORAS intersection guidance and the linked Movement and Place design-solutions library to confirm corner radii, pedestrian/cycle priority and lane arrangement appropriate to the identified street type; document any departures in Design Report.

7.2.4.1 Intersection Design Minor Intersections

In addition to the general intersection design requirements, minor intersections shall adequately cater for the turning paths of the appropriate design and checking vehicle. The design and checking vehicle for each intersection must be determined and applied in accordance with the Austroads Guide to Road Design and the Austroads Design Vehicles and Turning Path Templates Guide. Desirable kerb return radii shall generally be 9–12.5 m in urban residential areas and 12.5–15 m in industrial areas, measured from the face of kerb, with the actual radius confirmed by vehicle swept-path analysis to ensure the nominated design vehicle can turn without encroachment into opposing traffic lanes or over the kerb.

Prohibited Access Points

Where areas are highlighted as a prohibited locations for driveways, the use of roll top type kerb will not be accepted. The upright 150 mm high kerb type is to be deployed to encourage no vehicle access. Figure 2 below shows these prohibited zones in more detail.

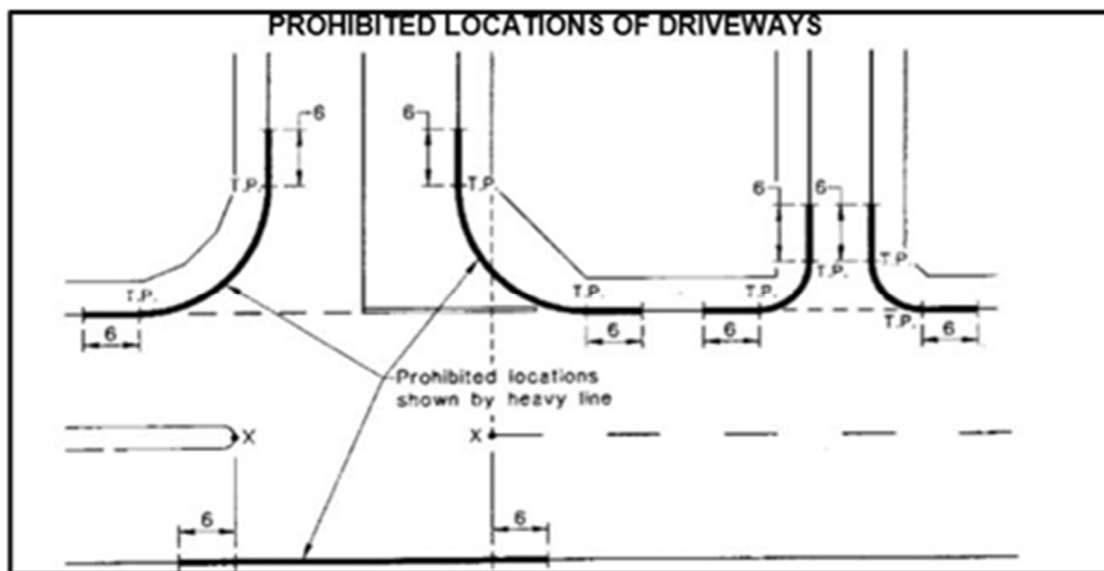


Figure 2: Prohibited Locations for Vehicular Access

Driveway access shall be located a minimum of 6 m beyond the tangent point of the kerb return.

Reference is also made to Hilltops Councils DCP regarding prohibited access points.

7.2.4.2 Intersection Design Classified Roads

Intersections or any traffic management proposals on, or connecting with, Classified Roads shall be designed and constructed in accordance with Transport for NSW (TfNSW) requirements. In accordance with Section 76 of the *Roads Act 1993*, a roads authority must notify TfNSW at least 28 days prior to commencing any major road work (estimated cost exceeding \$2,000,000 or as otherwise prescribed) and comply with any requirements issued by TfNSW in relation to the design, layout, geometric standards, drainage, pavement design and/or construction of works on Classified Roads.

7.2.4.3 Traffic Signal Design

Traffic signals on any road require the approval of TfNSW must be designed in accordance with TfNSW publication 08.092 Traffic Signal Guideline and the applicable Austroads Guides and Australian Standards and any applicable TfNSW Supplements to these guidelines and standards.

7.2.5 Roundabout Design

Roundabouts shall be designed in accordance with Australian Standards, Austroads publications and TfNSW Supplements.

Design criteria shall include, but are not limited to the following:

- Appropriate sight distance for vehicles, pedestrians and cyclists approaching and entering the roundabout. This includes adequate sight distance for pedestrians and cyclists entering the roundabout at design road crossing points from adjoining paths.
- Provisions for the future needs of Service Authorities.
- Adequate drainage.
- Site specific designed street lighting.
- Signposting and pavement markings.
- Safe provision for pedestrians and cyclists.
- Swept path of the largest vehicle realistically expected to use the roundabout.

The provision of safety barriers at roundabouts is not favoured. The need for such barriers should be avoided through careful design. Where barriers must be provided, they shall be TfNSW approved safety barriers.

Minor roundabouts for use as traffic calming devices in local roads must have signs and markings in accordance with AS 1742 Manual of uniform traffic control devices and the associated TfNSW Supplements. Preliminary geometric designs, design speed, design vehicle and the proposed formation of roundabout traffic islands shall be discussed with Council's Representative during the concept design stage.

Design vehicle turning paths shall be used to confirm that traffic within the roundabout will travel in compliance with the Australian Road Rules. Council's Representative will advise the design vehicle for each site, based on the road hierarchy, land-use zone and the Austroads Design Vehicles and Turning Path Templates Guide, including the recommended tracking offsets applicable to that vehicle

The provision of landscaping, when required, shall be designed so as not present any risk to the safe use of the roundabout. The design of landscaping needs to consider such matters as; the creation of hazards to errant vehicles, the loss of sight distance for vehicles and pedestrians throughout the growth cycle of any vegetation, interference to traffic and signs

for maintenance, interference with street lighting and any requirement for abnormal road vehicle passage.

Measures shall be installed to protect the road pavement and other infrastructure from landscaping-related effects such as hard surface runoff, excess irrigation water, tree roots, or soft edges. Raised hard landscaping is not to be provided other than in the middle areas of large roundabouts and then by approved design. Council's Representative will advise whether it is appropriate to incorporate raised hard landscaping or other features within a roundabout.

For multi-lane or high-activity environments, consult DORAS Appendix A.6 (Roundabouts) for NSW-specific common issues and preferred crossing solutions (e.g., grade-separated or set-back crossings), in addition to Austroads Part 4B.

7.2.6 Turning Facilities

7.2.6.1 Cul-de-sacs

Generally, permanent cul-de-sacs and turning heads are not supported by Council and through road networks are preferred. Where permitted by approved development plans, cul-de-sac layout criteria shall be as follows:

- Urban Residential
 - A minimum 12.5 m radius to the face of kerb, designed to accommodate the nominated design vehicle.
 - Entry and exit radii shall be provided in accordance with the turning path of the design vehicle, but shall not be less than 15 m.
 - The road reserve boundary shall be curved with a minimum radius of 17 m, to provide for a verge width not less than 5.0 m.
 - Where the head of the cul-de-sac is located on the low side of the road, provision shall be made to safely convey overland stormwater flows through easements or drainage reserves in accordance with Austroads Guide to Road Design Part 5A and 5B.
- Rural Residential
 - A minimum 13.0 m radius to the edge of the cul-de-sac head plus an additional 1.0 m sealed shoulder.
 - Entry and exit radii shall be in accordance with the turning path of the design vehicle, but not less than 15 m.
- Industrial
 - A minimum 16 m radius to the face of kerb, sufficient to accommodate the nominated design articulated vehicles. (Anticipated articulated design vehicle to be a B-Double RAV). Consideration to be given to no stopping/no parking to assist in heavy vehicle manoeuvrability.
 - Entry and exit radii shall be in accordance with the turning path of the design vehicle, but not less than 15 m, with adequate clearance for trailer overhang.
- Rural
 - A minimum 13.0 m radius to the edge of the cul-de-sac head plus an additional 1.0 m sealed shoulder.

- The road reserve boundary shall be curved to a minimum radius of 18.5 m to provide a verge width not less than 4.5 m subject to cut/fill batters and relative road reserve boundary location.
- Crossfall Grades
 - Minimum crossfall grade: 1%
 - Maximum crossfall grade: 6%
 - Maximum vector sum grade: 6%

Parking facilities, where required, shall be provided outside the turning areas.

7.2.6.2 Turning Heads

All variations of permanent hammer head turning facilities are not permitted due to road safety matters, for example relating to reversing waste vehicles are concerned.

7.2.6.3 Staged Development

All staged developments where a stage will terminate at a boundary of either property or that stage, a cul-de-sac head shall be provided irrespective of residual road length. This is a safety in design consideration ensuring where practically possible no reversing of a large vehicle is induced by the design that may result in an impact with a pedestrian.

A turning facility shall be provided to accommodate appropriate design vehicles. The cul-de-sac shall be the same as the road it serves. Cul-de-sacs shall adequately cater for the targeted service design vehicle turning paths.

When a proposed road is identified as a bus route and shall be constructed in stages and the accumulated or initial length warrants a bus service, a temporary turning facility shall be provided in accordance with this Specification.

7.2.7 Half Road Construction

Development of land, dual occupancies, townhouses, units, subdivisions and large developments fronting existing roads which are not kerb and guttered but contain a sealed portion of the carriageway will be required to provide a design and to construct road pavement shoulders and associated works including:

- Road shoulder construction being a minimum of 2.5 m marrying into the existing sealed pavement by 600 mm. Reference also section 7.2.8 Shoulder Construction.
- Safe intersection Sight Distance (SISD) engineering drawings showing sight lines at all nominated intersections including on existing roads.
- Stopping Sight Distance (SSD) to demonstrated satisfactory sight lines for the full frontage of the lot (Urban) or at nominated access's (Rural) driveways.
- Subsurface drainage.
- Stormwater drainage within the roadway and verge including provision for house drainage outlets - where made essential by the works.
- Kerb and gutter including vehicle access crossings for the new development.
- Verge formation - shaping to design standard profiles.
- Footpath/shared path paving.

- Table drains, tail in and tail out drains.
- Transitions of the new works to existing conditions beyond the site frontage.
- Adjustments of utility poles, mains and installations affected by the works.
- Provision of any signs, pavement marking, or other traffic control devices affected by or required by the works.
- Adjustment of fencing or driveways for adjacent properties affected by transitions.
- Revegetation of verge, street tree planting details
- Restoration of disturbed areas.
- Retaining walls and batters.
- Erosion control management drawings.

Design of such works shall detail the above listed elements as applicable, and any other works conditioned or required as a result of the conditioned works.

The design shall detail the ultimate full carriageway formation for the subject length of road plus a minimum length of 60m each side of the subject design. This is to show that the proposed design will adequately tie into the adjacent road formation. Where the design adjoins intersection or roundabouts, details must be provided how the design/construction ties into the intersection or roundabout.

Where works occur on main streets or local streets in NSW, cross-section staging and proposed verge/footpath allocations shall utilise Councils specified requirements and reference DORAS, Section 8 to maintain movement-and-place outcomes.

7.2.8 Shoulder Construction

Shoulder crossfalls must not be less than the existing adjoining pavement. The design edge of bitumen or lip of channel level should have a 3% crossfall from the ultimate design centre line levels as determined in the design. Crossfalls of the new pavement shoulders in the range of 2% to 6% may be acceptable provided the ultimate half road crossfall of 3% is achievable in the future.

The condition of the existing carriageway pavement and the ability to tie the proposed design levels to the existing pavements with appropriate transition lengths as defined in Council's Design Guideline - Standard Drawings will determine the extent of new pavement construction and/or reconstruction associated with the shoulder construction.

7.2.9 Upgrading Rural Public Roads

Rural public roads shall be designed in accordance with Austroads publications and TfNSW Supplements. Where the upgrading of a rural road is required, Council's Representative may advise on matters such as, but not limited to the following:

- Required road cross section.
- Required surfacing and pavement type and required pavement design.
- Design traffic loadings.
- Design Annual Exceedance Probability for flooding events for longitudinal and cross drainage.
- Table drain treatments and outlets.

- Effects on farm dams.
- Applicability of street lighting.
- Need to comply with NSWRFPS Planning for Bush Fire Protection Guide.

7.2.10 Extension of and Connections to Existing Roads

Where new works are required which extend or connect with an existing road, the Design Drawings shall detail connect 60m past the scope of works to detail connections.

Transitions shall be designed to safely and efficiently merge the new Works with existing road pavements, road shoulders, table drains, path width and shape, existing vehicle access crossings, driveways, traffic control devices and other features in the road reserve.

Transition designs must not create roadside hazards such as utility poles, vehicle access crossings, driveways, deep edge drains, steep path paving at the start and end of works. The design must address any identified hazards and be included in the scope of works.

7.2.11 Local Area Traffic Management (LATM)

Local Area Traffic Management (LATM) devices are required to reduce travel speeds to achieve nominated operating speeds. This is generally required where road geometry cannot satisfy the existing posted speed requirement. LATM devices may also be required by a Development Control Plan, Development Consent or formalised LATM Plan.

LATM device design and spacing must be part of an overall traffic calming scheme within the local precincts or Local Area Traffic Management Plan.

LATM devices must be designed in accordance with Austroads Guide to Traffic Management Part 8: Local Area Traffic Management, AS 1742.13 Manual of uniform traffic control devices - Local area traffic management, TfNSW Supplements and Council's Engineering Guideline - Standard Drawings.

7.2.12 Traffic Facilities

Traffic facilities must be designed in accordance with Australian Standards, Austroads publications and TfNSW Supplements.

7.2.12.1 Traffic Control Devices, Regulation of Traffic and Local Transport Forum Referrals

All traffic control devices must be designed and documented in accordance with the Austroads Guide to Traffic Management (current edition), the AS 1742 series (Manual of Uniform Traffic Control Devices), relevant Australian Standards, and current Transport for NSW (TfNSW) Guides, Technical Directions and Supplements.

On Council-managed roads, Council may exercise the functions authorised under the 2025 Authorisation and Delegation – Prescribed Traffic Control Devices and Regulation of Traffic. This delegation does not apply to TfNSW-controlled roads, which remain subject to TfNSW consent.

Referral of proposals to the Local Transport Forum (LTF) is mandatory where:

- The proposal restricts or prohibits passage along a road, or compels or prevents a turn, for a period greater than 6 months; or
- The proposal prevents, impedes or hinders the safe or efficient operation of a public passenger service for more than 24 hours; or

- The proposal prevents access to a public transport stop, wharf or station; or
- The proposal removes or makes less effective any bus priority measure for more than 24 hours.
- Regulatory Road signage.

Where none of these conditions apply, referral to the LTF is optional at Council's discretion.

If a prescribed traffic control device is installed without a mandatory referral, a record of the device (type, location, date) must be tabled at the LTF within 3 months.

Council must consult public transport operators if a proposal is likely to affect services, allowing a minimum of 7 days for comment, and must notify NSW Police Force and TfNSW at least 7 days before any public event requiring regulation of traffic.

Works relating to traffic signals may only be carried out by or with the consent of TfNSW. Any works on TfNSW-controlled roads also require TfNSW consent.

Changes to speed zones are not authorised under the Instrument and must be referred directly to TfNSW.

In urban contexts, confirm device layouts against DORAS street-type objectives to ensure the device supports the desired place and movement function, complementing AS 1742, AGTM and TfNSW Supplements.

7.2.12.2 Signs, Pavement Markings and Delineators

Signs and pavement markings must comply with the TfNSW Delineation Guidelines (current edition). Where the TfNSW Guidelines do not address a particular treatment, design and detailing shall follow the Austroads Guide to Traffic Management, the AS 1742 Manual of Uniform Traffic Control Devices and other relevant Australian Standards, or as otherwise agreed in writing by Council's Representative.

On Council-managed roads, the installation of any prescribed traffic control device (including regulatory signs, pavement markings and delineators) is determined by Council under the 2025 Authorisation and Delegation – Prescribed Traffic Control Devices and Regulation of Traffic. Where a proposal meets the thresholds outlined in 7.2.12.1, it must be referred to the Local Transport Forum (LTF) for advice prior to Council's decision. Where no mandatory referral applies but a prescribed traffic control device is installed, Council must table a record of the device at the LTF within 3 months. Works on TfNSW-controlled roads or those affecting traffic signals require the written consent of TfNSW.

- The following specific requirements apply to new roads:
- Roads having carriageways greater than 6 m shall provide centre line marking for a minimum of 10 m on approaches to intersections and on horizontal curves. Raised reflective pavement markers (RRPMs) shall be installed along the centre line of curves and for 15 m each side of the tangent point at 3 m centres.
- Road carriageways 11 m or wider shall provide centre line and edge line markings with RRPMs, or another pavement marking treatment as approved by Council's Representative.
- Centre line and edge lines shall be provided on rural roads where warranted by geometry, traffic volumes and safety needs, in accordance with the TfNSW Delineation Guidelines. Edge lines shall not be used unless a dividing line exists and the pavement is at least 6.8 m wide.

- All dividing and edge lines, where provided, shall be supplemented by RRPMS.
- Pavement markings shall be installed in accordance with Council's Engineering Guideline Specification – Construction Specification, the applicable Standard Drawings, and TfNSW QA Specification R141 Pavement Marking.
- Where conditions of a development consent require, Local Area Traffic Management (LATM) devices shall be designed and installed in accordance with the Austroads Guide to Traffic Management Part 8: Local Area Traffic Management and AS 1742.13.

For main streets and local centres, verify signage and marking schemes alongside DORAS design solutions (e.g., reduced kerb radii, kerb buildouts, single-stage or priority crossings) to reinforce target speeds and priority for vulnerable users.

7.2.12.3 Guideposts

Guideposts shall be provided in accordance with TfNSW requirements as a minimum. Provision of additional guideposts may be required considering local conditions such as the prevalence of fog, use of the road, driver behaviour, likely driver awareness and the adjoining sections of road. Guideposts shall be provided on all rural roads.

7.2.12.4 Street Signs and Naming

Street name blade location and type shall be of the standard type approved by Council's Representative, in accordance with Council's Engineering Guideline – Construction Specification Section 16 (Traffic Signs, Pavement Marking and Road Safety Barriers) and Council's Standard Drawings.

Developers must submit proposed street names to Council for review. Names are to be selected from Council's approved register of names or otherwise demonstrate compliance with the Geographical Names Board (GNB) Guidelines, the *Geographical Names Act 1966*, and the NSW Addressing Policy and User Manual.

Council has a preapproved list of names, that do not require additional submission to the GNB.

Council will confirm with the proponent whether the proposed names are appropriate and acceptable for submission. Once confirmation is provided, Council will complete the formal road naming process with the GNB via the NSW Place and Road Naming Proposal System. This includes submission, review, approval, and gazettal of the road names by the GNB.

The GNB must approve the name, spelling, road type (e.g. Street, Road, Avenue) and any dual naming before the name is gazetted and becomes official.

For roads or streets designated as private, the words PRIVATE ROAD shall be included beneath the road name blade, unless otherwise approved by Council's Representative.

Council shall be the sole supplier of road/street blades. This by way of private works arrangement with council.

7.2.12.5 "No Through Road" Signs

"No Through Road" signs shall be provided and placed in accordance with AS 1742 Manual of uniform traffic control devices and Council's Engineering Guideline - Standard Drawings and details as advised by Council's Representative. In the instance of staged road extensions, the sign shall be relocated or removed as appropriate to suit new works.

7.2.12.6 Safety Barriers

Safety barriers shall be provided in accordance with the TfNSW standards and Austroads warrants, guidelines and TfNSW Supplements and shall be shown on the Design Drawings. Only TfNSW-approved safety barriers shall be accepted for use on Council's roads.

Elimination of hazards in lieu of installing safety barriers shall be considered prior to detailing any requirement for a safety barrier.

Safety barrier selection type shall be given due consideration to vulnerable road users. The use of Elsholz kerb in local roads is discouraged and shall only be used with approval by Council's Representative. Where Elsholz kerb is installed adjacent to a path or footway, an appropriate pedestrian fence shall be erected to protect pedestrians from the vertical drop to the road pavement.

All details of the specified barrier type and any impacts resulting from the proposal shall be addressed in the design documentation, including post embedment/foundation or base plate fixing details. Delineation of safety barriers is required in accordance with the TfNSW standards.

A sealed shoulder shall be provided extending to the rear of the safety barrier post to minimise maintenance activities.

Rub rails or safety railings shall be provided to the rear of the safety barrier where there is an adjoining pedestrian or shared path system.

7.2.12.7 Bus Stops

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

The locations of bus stops shall be determined on each individual development in consultation with the relevant bus company and Transport NSW. Bus stops and associated infrastructure shall be designed in accordance with the Australian Human Rights Commission's Guideline for promoting compliance of bus stops with the Disability Standards for Accessible Public Transport (DSAPT) 2002, Disability Discrimination Act 1992 and Council's Engineering Guideline - Standard Drawings, in consultation with Council's Representative.

Bus stop shelters shall be provided in urban settings only at bus stop locations as determined by Council's Representative.

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

Bus stops and shelters should always be located on the departure side of walkways and cycle paths. The need to locally widen verges to provide visibility from adjacent driveways and intersections should be ascertained. It may be necessary to widen the road reserve width for bus bays.

School bus RURAL laybys shall be provided within the development and in certain circumstances along existing roads that a development may front.

The design of the rural laybys shall be in accordance with Austroads publications and TfNSW supplements. The general location of the laybys is to be spaced at approximately 300 - 450 m and can be incorporated on the departure side of a vehicle access and on the

lead into a cul-de-sac head. The pavement is to match the road pavement. The school bus laybys shall be signed posted for each approaching travel lane.

7.2.12.8 Earth

The following maximum batter slopes shall apply to facilitate maintenance of grassed batters in road reserves (all given as Horizontal to Vertical slopes):

- Fill batter:
 - Desirable 6:1
 - Absolute maximum: 4:1
 - Rural road design: 2:1 batters may be considered where adequate alternative bank treatment is provided via a Geotechnical Report and recommendations of a Qualified Certified Geotechnical or Civil Engineer (NER Registered).
- Cut batter:
 - Desirable 4:1
 - Absolute maximum: 1.5:1 may be considered where adequate alternative bank treatment is provided via a Geotechnical Report and recommendations of a Qualified Certified Geotechnical or Civil Engineer (NER Registered).
- Rock:
 - Rock batters are not permitted between 0.75:1 and 1.5:1 without the investigations, risk assessment and recommendations of a Qualified Certified Geotechnical or Civil Engineer (NER Registered).

The following maximum batter slopes shall apply:

- Fill batter: Faced with large angular rock: Maximum 1.5:1
- Cut batter: Solid rock with few clay bands: Maximum 0.25:1
- Less stable rock: Maximum 0.5:1

Where only short lengths of rock cuttings are encountered (30m or less) the rock cut batters must match any adjacent earth cut batters to improve aesthetics.

For shallow batters (up to 1m in height) it is preferred practice to flatten batters as much as possible for improved appearance.

When a retaining wall is necessary the Service Provider must provide full engineering details of the proposed structure, including elevation(s) and typical cross section(s).

Batters shall be designed to provide adequate stability for existing physical features and improvements on the verge where practicable to avoid the need for relocations or adjustments.

Batters within new subdivision Lots or developments shall commence at the property boundary and intersect the natural surface prior to proposed building alignments. An easement may be required via an 88B notation for support shall be provided where fill batters steeper than four (4) horizontal to one (1) vertical (4:1) encroach on private land requiring additional building control protection.

Lot access batters shall provide adequate sight distance in accordance with the design speed. This may require widening of level area behind the kerb to achieve the required sight distance.

Further guidance on the suitability of various batter surface stabilisation techniques can be found in the TfNSW publication Guideline for Batter Surface Stabilisation using vegetation.

7.2.13 Batters Outside Road Formation (Subdivision Lots and Reserves)

Road batters shall extend for as little distance as possible into proposed urban lots, such as to allow free surface runoff and vehicle access gradients to the building line. Minor smoothing out of the batter alignment at top and toe is permitted.

Consideration shall be given to future vehicle access grades particularly where cut/fill building platforms will be utilised.

Permanent cut or fill batter slopes shall nominally comply with six horizontal to one vertical (6:1) maximum slope except when allowed under the following circumstances. An increased localised slope of four horizontal to one vertical (4:1) maximum slope may be considered where:

- The batter when stabilised can be reasonably maintained; and
- Due to the terrain, road batters would extend significantly beyond the lot building line over a number of consecutive lots; or
- Flatter batters would result in the destruction of important stands of trees or individual tree specimens; or
- Particular environmental or land stability issues are significantly adversely impacted by flatter batters; or
- The batter impacts significantly on utility mains.

An increased localised slope of two horizontal to one vertical (2:1) maximum slope may be considered where:

- A Geotechnical Engineer's report is provided containing relevant, investigations, site assessment and recommendation; and
- The batter is within proposed private property, does not obstruct access onto any lot and when stabilised can be reasonably maintained.

In rock cuttings, faces steeper than two horizontal to one vertical (2:1), up to 0.25:1 may be permitted only where:

- Particular environmental, land stability or unreasonable construction cost issues are impacted by the alternative use of flatter batters; and
- Geotechnical Engineer's report is provided for consideration which identifies an expected long-term stability, low potential for weathering and lack of any need for routine maintenance; and
- Upon completion of the cutting a Geotechnical Engineer's report is provided which confirms the expectations of the pre-construction report or provides alternatives supporting the as-constructed works for approval by Council's Representative.

In any instance the method of stabilising fill batters greater than six horizontal to one vertical (6:1) shall be endorsed by the Geotechnical Engineering Consultant both at the design stage by way of design recommendations and following construction.

7.2.13.1 Road Batters for Road Formations

Road batters in rural roads may be influenced by matters including (but not limited to) the following:

- Terrain (environmental damage, drainage, benches, earthworks construction cost, etc).
- Safety (geometric design, clear zones, traversable slopes, safety barriers, etc).
- Sight distance requirements (curve and intersection benching, accesses, etc).
- Ground conditions (soil and rock properties, subsurface water, slope stability, etc).
- Constraints (existing/planned road boundaries, structures or services).
- Surface stabilisation and maintenance considerations.
- Appearance (constant width batters, batter slope treatments, non-obtrusive, etc).
- Placement of appropriate ground cover and planting with native vegetation.

The Designer will need to ensure that relevant information is available and that the design addresses pertinent matters. This may involve the preparation of design options to gain an approval.

Batters within the clear zone, particularly those in cuttings with a jagged rocky face, shall be either protected from vehicular impact by a safety barrier or be treated to promote sliding when impacted by a vehicle.

Batters must be designed as stable slopes complying with the following slopes unless advised by a Qualified Certified Geotechnical or Civil Engineer (NER Registered) or requested by Council's Representative. A Structural Engineer's design is required for rock batters greater than 1.5m in height.

7.2.14 Retaining Walls for Road Formations

As a minimum standard, retaining wall designs shall be carried out in accordance with AS 4678 Earth retaining structures and Section 9 - Design of Structures of this Design Guideline.

Retaining walls to support public road formations may be permitted only where:

- Particular environmental, land stability or land use issues are significantly adversely impacted by the alternative use of batters; and
- Proposed construction materials of the retaining wall are durable natural stone, masonry units or some other masonry components associated with an engineered retaining system; and
- Retaining walls are designed to accommodate loadings from road plant used to construct and maintain works within the road reserve; and
- Retaining walls are designed to accommodate loadings and excavations by plant used in the installation and maintenance of utility mains and installations; and
- Retaining walls are constructed in a form which does not require routine maintenance; and
- Retaining walls are constructed wholly within the road reserve; or

- Where the retaining wall(s) is located within any lot, an easement for support, drainage and maintenance shall be created in favour of Council over the retaining wall(s) and include a minimum 2.5m wide maintenance area.

Retaining walls to support land above a public road reserve may be permitted only where:

- Particular environmental, land stability or land use issues are significantly adversely impacted by the alternative use of batters; and
- Proposed materials for construction of the retaining wall are durable natural stone, masonry units or some other masonry components associated with an engineered retaining system; and
- Retaining walls are designed to accommodate loadings from plant used to perform construction works for the subdivision or lot development; and
- Retaining walls are set back at least 300mm into lots from the road boundaries and are designed to be stable in the event of excavation of adjacent utility services to the depth of the original or proposed respective utility services' trench; and
- Extent of the retaining wall shall not unreasonably restrict the future use of a lot; and
- Retaining walls are contained wholly within the private land which it supports or within an easement over other private land which allows for the existence, maintenance and rebuilding of the wall; and
- All surface or subsurface drainage systems associated with the retaining wall are piped to an approved drainage system.

In any instance, the following shall apply:

- All retaining walls must be certified by a Qualified Certified Structural or Civil Engineer (NER Registered) and shall be fit for purpose.
- Council Representative's approval must be provided.
- Any batter or retaining wall at an intersection or defined point of access shall be of an alignment and profile which provides adequate sight distance for passing and entering vehicles, pedestrians and cycle traffic; and
- Extent of any batter or retaining wall fronting a lot, including frontages of public land, shall not obstruct access onto that lot or land.
- Minimum design life for retaining walls associated with road formations shall be 100 years.
- Finished appearance and any applicable heritage considerations shall be integral to the selection of the type of retaining wall.
- Construction and maintenance costs and constructability shall be integral to the selection of the type of retaining wall during the design process.

8 Design of Pavements

8.1 General

This section outlines the minimum requirements for geotechnical investigations and the design of pavements for:

- Public roads (existing and proposed including minor works).
- Footpaths.
- Shared paths.
- Driveways and accesses.
- Public and private car parks.

8.1.1 Preparation and Council Acceptance of Reports

A Pavement Design Report covering all proposed pavements shall be prepared by a Qualified Certified Geotechnical or Civil Engineer (NER Registered) and submitted to Council for review. The report shall be accepted by Council prior to applying the report's recommendations to any works.

Pavement Investigation and Design shall be addressed with reference to current Austroads Guide to Pavement Technology - Set, other Austroads pavement design related publications and the relevant TfNSW Supplement(s) unless otherwise required in this Design Guideline or circumstances warrant otherwise, as agreed with Council's Representative.

8.1.2 Small Pavement Projects

For small pavement projects, up to 100m long and 3m wide and pavement restorations where Council's Standard Pavement designs apply, the requirement of a Pavement Design Report may be removed at the discretion of Council's Representative. Refer to Council's Engineering Guideline - Construction Specification Section 9.2.1 Flexible Pavement for Road Shoulder, Half Road and Kerb and Gutter.

8.1.3 Roads within Floodways

Roads within floodways that are designed to be inundated more than once every 20 years, or roads over lands which are subject to inundation or saturation shall be designed to suit the specific site conditions. Poor subgrade material with the potential for subsidence shall be reviewed for the need to preload the site before placement of the design pavement. The Geotechnical assessment of the subgrade and pavement design is to be approved by Council's Representative.

8.1.4 Pavements for Private Ownership

Other than battle-axe driveways for subdivisions and vehicle access crossings (VACs) the information contained in this Section in relation to private accesses and car parking is for guidance only unless otherwise specified in a Development Consent. Service Providers must be aware of requirements of the National Construction Code any applicable Australian Standards, documents referred to in Development Approvals and product information when specifying such matters as vehicle access crossings, driveways, parking areas and pathway pavement surface materials or surface finishes which will not become Council's assets.

8.1.5 Pavement Design Life

The minimum design life of new and upgraded public road pavements shall be 40 years and is to include provision of school bus/waste vehicles unless otherwise specified in the conditions of Development Consent.

8.2 Pavement Design Report

The Pavement Design Report shall address the following matters as a minimum:

- Projected traffic loadings and vehicle impacts.
- Subgrade and underlying material evaluation including test results from a NATA Registered Laboratory.
- Standard Compaction to be specified.
- Expansive soils and moisture control.
- Subgrade and pavement subsurface drainage design details.
- Environmental factors found and considered.
- Consideration of consequences of other development works.
- Materials requirements if not in accordance with or specified in Council's Specification - Construction Specification.
- Proposed use and suitability of recycled pavement and/or subsurface materials.
- Construction methods and issues.
- Pavement layer thickness design.
- Wearing surface details.
- All clarifications for the supply, placement and saw cutting requirements for heavily bound pavements shall be contained in the approved Pavement Design Report.

Other geotechnical matters pertinent to the works may be included in the Pavement Design Report or presented in separate reports. These matters may include but are not limited to:

- Topsoil stripping requirements.
- Slope stability.
- Rock strength and hardness.
- Suitability of materials for fill formations.
- Potential for subsidence.
- Identification of unsuitable materials.
- Groundwater issues, cut batters, fill formations (capillary action), fill batters, slope stability and drainage run-on.
- Foundation design criteria for structures.
- Construction vibration damage risk.
- Retaining wall design criteria.
- Actual and Potential Acid Sulphate Soil (ASS) sampling testing and management plan.

- Virgin Excavated Natural Material (VENM) sampling testing and management plan.
- Excavated Natural Material (ENM) sampling testing and management plan.
- Testing for salinity.
- Recommendations concerning road levels and treatments in relation to ground conditions arising from presence of hard rock, unsuitable ground and potential instability.

8.3 Design Traffic Loading

Pavement designs for all proposed public roads shall be based on the road types as defined in Table 5 Road Hierarchy and Road Width Schedule for a 40-year design life.

The design traffic loadings will be as nominated, in conditions of the Development Consent or by Council's Representative. Any submission to vary traffic loadings shall include full calculations.

Design of rigid pavements must be based on the ESAs and must be converted to the appropriate measurement using the methodology detailed in Austroads Guide to Pavement Technology.

8.4 Evaluation of Subgrade

Investigation by a qualified practicing Geotechnical Engineer and soils testing through a NATA registered laboratory will be required. Testing and test samples shall be undertaken at the approximate design subgrade level.

The design of rigid pavements requires the determination of an Equivalent Design CBR. This calculation considers subgrade material properties to a depth of 1m. See Austroads Pavement Guide to Pavement Technology - Set and the relevant TfNSW Supplement(s).

Investigation of materials below subgrade level is also necessary to assess subsurface moisture and to expose any weak layers below the subgrade. Test pitting, recording of bore logs and materials sampling shall be carried out to include materials to a minimum depth of 1m below design subgrade or to the next material layer change where ground is found to be soft or loose. Subgrade conditions including CBRs and depths to rock shall be confirmed by a practicing Geotechnical Engineer.

In deep cuttings, deep fills or other instances where testing of subgrade is possible only after bulk earthworks, pavement designs may be assumed for the purpose of submitting the Pavement Design Report for approval. In areas where pavement designs have been assumed, pavement investigations, sampling and testing shall be carried out in full upon excavations reaching subgrade level and then a Pavement Design Report shall be prepared and submitted for acceptance by Council's Representative.

8.4.1 Determination of Design Subgrade CBR

Sampling for laboratory CBR testing is to involve the following:

- Minimum of one sample at any sampling location for each subgrade material present to 1m below subgrade.
- Maximum spacing of 60m* between subgrade sampling locations in residential roads or part thereof.
- Maximum spacing of 150m* between subgrade sampling locations in rural roads or part thereof.

- Minimum of two subgrade sampling locations in each road within the proposed work site.

** Repeated laboratory CBR tests on the same material-type sampled throughout a site is not required provided that in-situ testing is undertaken to justify allocating a CBR based on a pair of laboratory results for that material. In-situ testing for determination of the CBR may be carried out using a cone penetrometer for fine grained materials. A laboratory CBR test will be required for materials containing larger particles where consistent results are not obtained by a Cone Penetrometer. The determination of design CBR values shall be compliant with Austroads Guide to Pavement Technology: Part 2 – Pavement Structural Design, including adoption of the 10th percentile CBR for each material unit.*

8.4.2 Expansive (Reactive) Soils

Sampling and testing of subgrade materials is also to be carried out to determine their “Expansive Nature” classification in accordance with Austroads Pavement Guide to Pavement Technology - Set and the relevant TfNSW Supplement(s). Testing is to include the potential swell test in addition to the plasticity index test.

Design measures to control movement of the subgrade are required for pavements over expansive soils classified “high” or “very high”. Design measures and subsurface drainage are discussed in Austroads Pavement Guide to Pavement Technology - Set and the relevant TfNSW Supplement(s). Preferred measures shall also be discussed with Council’s Representative prior to inclusion in any Pavement Design Report.

Pavement subsurface drains generally are not to extend into highly or very highly expansive road subgrade soils. Drainage lines and utility mains laid in sand or aggregate bedding material are not to be in or in close proximity to highly or very highly expansive road subgrade soils.

The Geotechnical Engineer is to recommend appropriate treatments to control moisture variations in highly and very highly expansive subgrade soils, subsurface drainage treatments in general and general measures to prevent infiltration of surface water.

8.5 Subsurface Drainage

Subsurface drainage will be required for all new road pavements in order to:

- Prevent groundwater from entering and softening or saturating the subgrade or pavement materials.
- Remove trapped water that enters a pavement either from the side or from beneath the pavement.
- Control moisture levels in subgrade material to prevent reactive soils from damaging pavements.
- Prevent slope instability.
- Achieve consolidation in raised embankments over wet or unstable areas.

The general location for pavement subsurface drainage shall be located as shown on Council’s Specification - Standard Drawings. Pavement subsurface drainage shall be required on both sides of the roads.

Recommendations for subsurface drainage shall be made by the Geotechnical Engineer in the Pavement Design Report where different requirements to those shown on Council’s Standard Drawings are considered necessary by the Geotechnical Engineer.

Recycled materials may be used, provided they meet the requirements of the relevant standards. The Service Provider shall obtain sample coarse particle size distributions from the manufacturer which is representative of the material to be used on site and submit them to Council's Representative for approval prior to use.

Refer to the IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010 for further information; and TfNSW QA Specification 3154 Granulated Glass Aggregate and TfNSW QA Specification 3580 Aggregate Filter Materials for Subsurface Drainage for the applicable material and subsurface application requirements.

8.6 Flexible Pavement Design

Asphalt surfacing of 40mm thickness or less over an unbound flexible pavement is not considered to contribute to pavement thickness structural design.

Notwithstanding other requirements of this Section, the design minimum compacted pavement thickness, including asphalt surfacing, shall generally not be less than 300 mm on public roads or on roads which shall become Council's asset following dedication. In local access streets with low traffic demand ($\leq 10^5$ ESAs) and subgrade CBR ≥ 15 , Council may permit a reduced thickness of 250 mm were supported by an Austroads-compliant pavement design and approved by Council's Representative.

Pavement wearing surface between 30mm and 45mm thick must utilise 10mm size aggregate. The use of 14mm aggregate for wearing surfaces must only be used in wearing surfaces greater than 45mm thick unless otherwise approved by Council's Representative.

In addition to the requirements of this Design Guideline, flexible pavement investigation and design shall generally be carried out in accordance with Austroads Pavement Guide to Pavement Technology - Set and the relevant TfNSW Supplement(s).

8.6.1 Wearing Surface – Bituminous Spray Sealing Design

Design shall be completed using the 395K TfNSW form or equivalent by a suitably qualified/experienced consultant. The bitumen seal design is to be forwarded to Councils representative for approval as part of the Subdivision Works Hold Point process and prior to the works being conducted.

For all new works, a double/double (two coat) seal is to be provided. The first coat being a 14mm seal, with the second coat being a 7mm seal. For heavy turning areas like cul-de-sac heads, a third additional 7 mm seal is to be also completed.

Alternatively for heavy turning areas (intersections/cul-de-sacs and industrial areas), asphaltic concrete or concrete pavements should be considered.

8.7 Rigid Pavement Design

Rigid pavements on public roads shall be designed in accordance with Austroads Guide to Pavement Technology Part 2: Pavement Structural Design and by a certified practising structural engineer.

The minimum requirements for rigid pavements for public roads, other than roundabout pavements, shall include a sub-base course of 125mm bound or 150mm unbound material and a concrete pavement thickness minimum 165mm 32MPa (3.5MPa flexural strength).

Jointing details for rigid pavements shall be detailed on separate Design Drawings and generally be in accordance Austroads publications, TfNSW Specifications and other Australian design publications on concrete pavement design, which may be relevant to the

subject pavement. Details of documents referenced in detailing rigid pavement designs shall be provided to Council's Representative with the Design Drawings.

8.8 Asphalt Pavement Design

The following applications of asphalt for pavements may be acceptable. Details of individual pavement designs including or nominating materials specifications, if differing from Council's Specification, shall be included in the Pavement Design Report. Consideration shall be given to additional depth and specification of asphalt in cul-de-sac turning heads.

- Dense Graded Asphalt.
- Full Depth Asphalt
- Modified Full Depth Asphalt (MFDA).
- Deep Strength Asphalt.
- Wearing surface asphalt containing plastomer Polymer Modified Binder.
- Composite Pavements - initial sprayed seal on lean mix concrete or bound sub-base.
- Open Graded Asphalt.
- Warm Mix Asphalt.

Reclaimed asphalt pavement (RAP) material may be used in asphalt pavement mix design in accordance with the following specifications, subject to the Geotechnical Engineer's/Pavement Designer's approval and if agreed to by Council's Representative:

- TfNSW QA Specification 3152 Aggregates for Asphalt.
- TfNSW QA Specification 3153 Reclaimed Asphalt Pavement Material.
- TfNSW QA Specification R116 Heavy Duty Dense Graded Asphalt.
- TfNSW QA Specification R117 Light Duty Dense Graded Asphalt.

Refer to the IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage 2010 for further information and the relevant asphalt specifications for permissible level of RAP for the applicable product and pavement application requirements.

8.8.1 Sprayed Seal Under Asphalt Surfacing

All asphalt surfacing shall be placed on a bitumen seal in accordance with Council's Engineering Guideline - Construction Specification.

8.8.2 Edge Drains for Asphalt Pavement Layers

In order to relieve moisture from asphalt pavement layers, effective edge drains are to be considered as part of the pavement cross section of full depth, deep strength, open graded and modified full depth asphalt pavements.

8.9 Interlocking Segmental Block Pavement Design

Interlocking segmental block pavement designs shall be approved by Council's Representative and shall comply with the following requirements:

- Interlocking segmental block pavements shall consist of concrete or similar pavers.
- All areas of paving shall be constrained by an approved concrete edge restraint.

- Provide adequate surface and subsurface drainage.
- Be laid on a reinforced concrete slab for stability.
- Paving is not permitted on grades above 5%.
- Pavers shall have a minimum slip resistance surface classification of Class W under AS/NZS 4586 Slip resistance classification of new pedestrian surface materials - Wet Pendulum Test Method using Four S Rubber (*Standard Shoe Sole Simulant*- simulated standard shoe sole rubber) referenced as Slider 96.

Further details are provided in Council's Engineering Guideline - Standard Drawings

8.10 Roundabout Pavement Design

The pavement shall be designed to suit the roundabout size and design traffic loadings and vehicle turning movements. The following pavement treatments may be considered and shall be approved by Council's Representative.

8.10.1 Roundabout Full Depth Asphalt Pavement Design

The Pavement Design Report shall include justification of the selection of asphalt modulus values used in the design and specify wearing surface, layer thickness and aggregate size. The design modulus and volume of binder is to be determined via the Shell Nomographs presented in Section 6 of Austroads Guide to Pavement Technology using an appropriate WMAPT and a maximum design speed of 40km/h. Use 10km/h within 50m of intersections.

Roundabouts may have pavements constructed in Modified Full Depth Asphalt (MFDA) where the natural subgrade CBR is greater than 10% and the design traffic before factoring for torsion effects does not exceed 5×10^6 ESAs.

8.10.2 Heavily Bound Pavements

Heavily bound Pavement Design Reports shall include references to heavily bound pavement material specification and other construction requirements, including individual asphalt layers and asphalt mix type. All clarifications for the supply, placement and saw cutting requirements shall be contained in the approved Pavement Design Report.

Unbound or bound granular materials, other than heavily bound granular materials, are not permitted in roundabout pavements.

8.10.3 Roundabout Rigid Pavement Design

Rigid pavements for roundabouts shall be designed with reference to TfNSW Concrete Roundabout Pavements, A guide to their design and construction and any current information published by the TfNSW in relation to concrete roundabout pavements.

8.11 Industrial and Commercial Area Road Pavement Design

Pavement designs for roads in industrial and commercial areas shall consider the possibility of high-volume heavy turning movements with resulting surface torsion effects and braking forces. Thin asphalt surfacing, which may be suitable for residential subdivision pavements, are not considered suitable for industrial and commercial area road pavements.

A heavily bound pavement with a thick asphalt surfacing is one alternative that could be considered when designing pavement for these areas.

8.12 Council Standard Pavement Design

In some cases of minor pavement works on local access roads and minor roads a Pavement Design Report may not be necessary. These cases generally consist of pavement shoulder works of 100m or less length, 3m or less in pavement sub-base width and where the subgrade CBR is expected to be greater than or equal to 5.

Under this scenario, the pavement thickness shall be placed at a minimum of 300mm, to 102% standard compaction for the required maximum dry density. A minimum of 2 compaction tests will be required per section or lot of works as determined by Councils Representative.

8.13 Temporary Roadwork at Temporary Road Ends

The pavement design of temporary road works for example detours or turning facility (turning heads/cul-de-sac) shall be as for the through road pavement. Consideration shall be given to:

- Surface drainage to be provided in the interim.
- Provision of subsurface drainage for the interim and ultimate conditions.

8.14 Temporary Side Tracks and Deviations

The design of temporary side tracks and deviation pavements required for construction shall be carried out to ensure that the following applies:

- Pavement will withstand the expected traffic loadings without deformation causing interference to traffic flow, speed or safety.
- Surfacing of the pavement will only require minor maintenance during the life of the pavement.
- Effects of surface and subsurface drainage are considered.
- Treatment of the interfaces with existing pavements is considered including subsurface drainage and interlocking of pavement courses.
- Minimum pavement depth requirements.
- Disturbed areas are returned to preconstruction condition at completion of the project.

8.15 Private Access, Paths and Battle-Axe Driveway

Private driveways may range from a single residential access to substantial internal road systems. These may provide access to a range of developments from single residences to major commercial or industrial developments involving high volumes of heavy vehicles. A design standard must be selected which is appropriate for the scale of the development, the anticipated life of the development and the traffic type. The standard to be used may also be specified in the conditions of Development Consent.

Pavements for battle-axe lot driveways servicing residential properties within proposed subdivisions shall be constructed in accordance with the requirements of Council's Engineering Guideline - Construction Specification. In addition, driveway and property access design shall comply with the relevant provisions of the Austroads Guide to Road Design Parts 3 and 4 in relation to property access, sight distance and geometric standards, and where pedestrian access is required along a battle-axe handle the requirements of Austroads Part 6A (Paths for Walking and Cycling) shall also apply.

The driveway pavement, width and turning arrangements must be designed to accommodate the expected traffic class, whether light vehicles for single dwellings or service and heavy vehicles for commercial and industrial development, and shall be integrated with appropriate drainage and sight distance standards. Proponents are required to demonstrate compliance with these requirements within their design report to Council's satisfaction.

8.16 Car Park Pavements

The design of car park pavements must consider variations in use and loading throughout the car park, including through-routes, locations of high turning movements, and heavy vehicle routes. The design life of private car parks shall be not less than 40 years for all permanent construction.

All loading bays and loading zones must be constructed in concrete or in other approved rigid or fuel-resistant pavement construction to resist damage from diesel and fuel spills. Paving colours shall be mottled to mask drip marks. Paving surfacing colours which would mask pavement markings must not be selected.

Car park wearing surfaces shall consist of asphaltic concrete, rigid pavement or segmental paving. Porous pavements will only be considered suitable for areas subject to light to medium traffic, and the design must demonstrate adequate subsurface drainage and subgrade support, which may require provision of additional porous pavement courses.

The placement of surface and subsurface drainage is critical to pavement performance and must be addressed in the Pavement Design Report. Subsurface moisture may be affected by steps in subgrades due to pavement depth variations, landscaped and irrigated traffic islands, service trenches, below-ground tanks, boxing and/or filling over broad areas, adjacent water quality systems (such as rain gardens and bioswales), and the use of pavement surfaces for on-site stormwater detention.

A detailed assessment of the need for surface and subsurface drainage must be undertaken for each site.

Design standards applicable to a particular development may also be specified within the conditions of Development Consent.

8.17 Concrete Paths

Concrete paths shall be constructed in accordance with the requirements of Council's Engineering Guideline – Construction Specification and Standard Drawings. Where shared paths are proposed to be used for vehicle access for maintenance activities or similar purposes, the shared path pavement shall be specifically designed for light-duty vehicular loading in accordance with Austroads Guide to Pavement Technology Part 2: Pavement Structural Design and Part 8: Pavement Construction, with details shown on the Design Drawings.

All footpaths shall be a minimum width of 1.5 m and not less than 100 mm thick, reinforced with SL72 mesh or equivalent steel fibre reinforcement. Wider widths shall be provided where required by the NSW Walking Space Guide (TS 01589) and Design of Roads and Streets (TS 00066) to meet accessibility and place-based requirements.

Cycleways shall be designed in accordance with Austroads Guide to Road Design Part 6A: Paths for Walking and Cycling, the NSW Cycleway Design Toolbox (TS 01590), and DORAS (TS 00066). Unless otherwise specified, cycleways shall be constructed in accordance with Council's standard drawings.

The finished surface shall be such to eliminate a slippery surface by way of broom or coved finish or other approved means.

In all cases the concrete shall have a characteristic compressive strength of not less than 25 MPa at 28 days. Where pavements are constructed in aggressive ground conditions, including soils or groundwater with elevated concentrations of sulphates, chlorides, or other salts that may catalyse deterioration of concrete and reinforcement, the designer shall select a concrete mix with appropriate durability characteristics. This may include specifying higher strength grades, reducing water/cement ratios, increasing cover to reinforcement, or incorporating supplementary cementitious materials (such as fly ash, slag, or silica fume) in accordance with Austroads Guide to Pavement Technology Part 4C: Materials for Concrete Road Pavements.

Curing, reinforcement cover, saw-cutting and expansion joint details shall be in accordance with Council's footpath specification.

8.18 Pavement Surfacing

In addition to the requirements of this section of the Design Guideline, other general requirements for pavement surfacing materials, thickness and finishes are specified in Council's Engineering Guideline - Construction Specification. However, where a particular circumstance is not covered in that Specification an appropriate treatment shall be discussed with Council's Representative prior to Council's acceptance for the use of the appropriate treatment.

8.18.1 Sealing of Unsealed Roads Near Occupied Homesteads/Shearing Sheds

If a development uses an unsealed council road to gain access to its property, and that intended route passes an occupied dwelling (be that a house/machinery shed/woolshed), and that building is close to the road and could be impacted by dust, the following shall apply:

- Conditions for consent for sealing will be limited to houses up to and equal to 100m from the front fenced boundary to the road.
- Sealing will be limited to 100m either side of the house location square to the centreline of the road.
- Sealing will comprise of a double/double (applications of bitumen and aggregate) seal of 14mm and 7mm aggregate.
- Minimum depth of road pavement will be 250mm, including existing pavement material.
- Pavement material will consist of complaint DGB20 road base.
- Sealing width will be limited to 7m to allow two vehicles to pass.
- The sealed pavement section will be surveyed and designed by an appropriately qualified person. An submitted in the standard design form articulated in this Engineering Guideline.
- Design drawings are to be submitted to Council for approval prior to the works. Design is to show impacts to existing table drains, culvert structures etc.
- If works extend to the undisturbed grass verge area, a biodiversity report will be required to safeguard any biodiversity impacted by the widening.

8.19 Vehicle Crossings

Vehicle crossings shall be designed and constructed in accordance with Hilltops Council's Vehicle Crossing Specification. For TfNSW network access, crossings must be designed in accordance with Austroads Guide to Pavement Technology Part 2: Pavement Structural Design (AGPT02-24).

Crossings must be constructed with adequate surface drainage and must not obstruct or concentrate stormwater flows. Where table drains exist, suitable culverts shall be installed in accordance with Council's requirements.

8.20 Rural/Residential and Rural Driveways

8.20.1 Driveways for Unsealed Roads

Where driveways access unsealed roads, they shall be constructed to an all-weather standard, comprising a minimum 200 mm compacted gravel wearing course ($\text{CBR} \geq 30$) over a prepared subgrade (minimum $\text{CBR} 5$), graded and drained to prevent scouring. The gravel shall be a material of suitable quality for unsealed pavements in accordance with Austroads Guide to Pavement Technology Part 6: Unsealed Pavements (AGPT06-09), with sufficient plasticity and grading to achieve adequate cohesion and to minimise imperviousness, ravelling, potholing, corrugation and dust generation. Where the natural subgrade has a $\text{CBR} < 5$, a custom pavement design shall be undertaken in accordance with Austroads.

8.20.2 Driveways from Sealed Roads

Where driveways access sealed local, regional or state roads, they shall be sealed from the edge of the public road pavement to the property gate. The minimum pavement shall consist of a 200 mm compacted granular base ($\text{CBR} \geq 80$, DGB20 or equivalent road base material) over a prepared subgrade (minimum $\text{CBR} 5$), surfaced with either a two-coat bituminous seal (14 mm / 7 mm) or 40 mm asphaltic concrete. Where the natural subgrade has a $\text{CBR} < 5$, a site-specific pavement design shall be undertaken in accordance with Austroads.

9 Design of Structures within Road Reserve

The design of structures such as bridges, large drainage structures and retaining walls shall be carried out in accordance with the current relevant Austroads publications, Australian Standards and Australian Rainfall and Runoff - A Guide to Flood Estimation.

Certification will be required from a Registered / Certified Practising Civil or Structural Engineer stating that the design has been prepared in accordance with the required guidelines, standards and Work Health and Safety legislation. Structural designs shall be accompanied by a Safety in Design Report that specifies the hazards relating to the design of the structure.

Design certification shall also be provided at construction stage to address the adequacy of the proposed formwork and construction methodology. Refer to Council's Engineering Guideline - Construction Specification for requirements.

Inspection certification from a certified practising Civil or Structural Engineer will be required confirming that construction has been carried out in accordance with the approved design. Refer to Council's Engineering Guideline - Construction Specification for requirements.

The design and manufacture of all precast structures shall be certified by a certified practising Civil or Structural Engineer as being in accordance with relevant standards. Refer to Council's Engineering Guideline - Construction Specification for requirements. Prior to approval for use of precast products all relevant technical information for installation shall be submitted together with the certification to Council's Representative.

9.1 Retaining Wall Design Requirements

Aesthetic and durability considerations shall be an important factor in the design of retaining walls, especially in road cutting situations. Natural stone products are the preferred material for use throughout the Hilltops region, concrete secondary, due to the local source of these products and the desirable appearance of retaining walls constructed using these materials.

Retaining wall structures include, but are not limited to the following:

- Retaining walls.
- Mass gravity (durable natural stone, brick and mortar).
- Gabion baskets.
- Stacked masonry blocks.
- Post and panel/waler (composite).
- Timber post and sleeper/waler
- Timber or concrete – crib

Retaining wall construction materials shall be either of the following (treated pine is not permitted unless designed to achieve the required design life and is approved by Council's Representative):

- First grade quarry sawn sandstone logs (preferred).
- Masonry units.
- Precast reinforced coloured concrete panels/walers with galvanised steel universal beams.
- Some other components associated with an approved engineered retaining system.

- May need to consider any applicable heritage value for existing retaining walls.

A retaining wall design by a Qualified Civil or Structural Engineer is not required if the retaining wall height is less than 1m and is not:

- Supporting a batter or natural ground steeper than four horizontal to one vertical (4:1); and/or
- Subject to live loads.

In addition to previously mentioned requirements, the retaining wall design drawings shall also include, but are not limited to the following information:

- Component type.
- Component size.
- Buried components.
- Drainage requirements including subsurface drainage and flush points.
- Location of existing and proposed public utility services in vicinity of retaining wall.
- MGA co-ordinates at each end of each site.
- Plan showing:
 - Horizontal alignment at toe.
 - Horizontal alignment at top.
 - Horizontal alignment of buried components; rock bolts, tie backs, etc.
 - Longitudinal section.
 - Typical cross section showing:
 - Footings.
 - Chainage.
 - Zone of influence for loading at back of retaining structure.
 - Zone of influence for excavation at toe of structure.

With reference to the above requirements, retaining walls designed by a Qualified Civil or Structural Engineer shall require the preparation of a Safety in Design Report, in accordance with the Work Health and Safety Regulation 2025, which should include the following information as a minimum:

- Purpose for which the item is designed.
- Hazards and risks to health and safety associated with the particular design for the whole life cycle:
 - Construction.
 - Operation.
 - Maintenance.
 - Demolition.
- Controls used to mitigate risks.
- Results of calculations, analysis, testing and examination.

- Hazardous properties of any substance.
- Conditions necessary to ensure safe use for the purpose it was designed or when carrying out associated activities.
- Residual risks.

The minimum design life for retaining walls associated with road cutting and embankment formations shall be 100 years.

10 Design of Property Access, Car Parks, Paths and Cycleways

10.1 General

This Section outlines the minimum design requirements for property access, car parks, paths and on-road cycleways. In addition to designs being in accordance with this Design Guideline, they shall also be designed in accordance with the appropriate Australian Standards, Austroads publication, TfNSW Supplements and Council's Engineering Guideline - Standard Drawings.

For NSW urban streets, designs shall also be checked against the NSW design of roads and streets (DORAS, TS 00066) for street-type consistency; any departures shall be documented in the design report.

Where a pavement is required for access, car parks or paths, submit a pavement design report consistent with Section 8.

10.2 Vehicle Access to Properties

For ALL vehicular accesses, the proponent shall provide longitudinal sections (centreline) and cross sections at (≤ 2 m for Urban & ≤ 10 m for Rural) intervals (and at all crests/sags/flushing points/grade changes) to demonstrate compliance with gradient, crossfall and drainage requirements.

10.2.1 Earthworks and Maintenance

When earthworks are required, the access shall be considered as a road for the purpose of design and constructed accordingly. Refer to Section 6 - Site Earthworks Design of this Design Guideline and Section 5 - Site Clearing and Bulk Earthworks of Council's Engineering Guideline - Construction Specification.

Maintenance of a vehicle access crossing, including any adjacent retaining wall and/or embankment constructed as part of a vehicle access crossing (where the beneficiary is the property owner), is the property owner's responsibility under the *Roads Act 1993*.

10.2.2 Urban Property Access

Urban property vehicle accesses include entrances from a single dwelling residence to major developments, such as shopping centres, car parks, or entertainment venues. Designs for urban vehicle access crossings need to consider the following:

- Road type adjoining property frontage.
- Land use of the property.
- Type of vehicles likely to use the access, such as cars, trucks and other heavy vehicles.
- Volume of traffic using the access.
- Street and property drainage.
- Existing and proposed utility services.
- Proximity to road features including but not limited to:
 - Intersections. Vehicle access location shall be from the closest edge of the access a minimum 5.5m from the intersecting side boundary line.

- Other property accesses.
- Street furniture.
- Street trees.

And include provisions for the following:

- The vehicle access crossing is to include gutter and path crossings in accordance with Council's Engineering Guideline - Standard Drawings.
- A pavement design in accordance with Engineering Guideline - Construction Specification or an approved Pavement Design Report as outlined in Section 8.
- The driveway gradient on the approach to the road boundary shall comply with Council's Engineering Guideline - Standard Drawings.
- The driveway gradients and surface material specification shall satisfy the relevant Australian Standards and National Construction Code requirements, including those regarding slip resistance for pedestrian access and mobility.
- The collection and discharge of driveway stormwater runoff including runoff from uphill areas. Driveway runoff is not permitted to flow onto any footpath, shared path or carriageway.
- Any batters or retaining structures shall not restrict development over adjoining land or pose risks of instability or erosion.
- Any requirements imposed in relation to fire either through the National Construction Code or in Bushfire Prone Areas, the NSW Rural Fire Services (such requirements may include controls on gradients, driveway widths, clearances and design vehicles for various travel paths).
- Completed works shall satisfy cover and clearance requirements for any utility authority mains and installations.

Vehicle access crossings of the road verge for residential developments shall be designed and constructed in accordance with AS/NZS 2890.1 Parking facilities: Off-Street car parking and Council's Engineering Guideline - Standard Drawings. When roll top kerb has been provided, no provision or modification for vehicle access crossing will be allowed.

Where a minor road type access is required with kerb returns and drainage pits cannot be provided in the public roadway a dish gutter shall be provided in accordance with Council's Engineering Guideline - Standard Drawings.

The vehicle access crossing or driveway layout must:

- Provide single manoeuvre turns by the design vehicle.
- Driveways are to be at 90 degrees to the constructed kerb or road centreline and must not extend past the prolongation of the side property boundary.
- There shall be a minimum clearance of 1 m from a stormwater drainage inlet pit. This pit may be relocated if required at the applicants expense, subject to Council approval.
- Provide adequate clearance between the design vehicle's turning path and physical constraints within the property.
- Avoid reversing movement into or out of the development (except in the case of individual residential houses).

- Provide safety for pedestrians by ensuring adequate sight distance.
- Minimise pedestrian/vehicle conflict areas and control vehicle speed across verges.
- Access to adjacent properties may be either fully combined or alternatively separated by a minimum distance of 2 metres.
- Where combined driveways are proposed, the maximum combined width shall be 7.5 metres.
- Driveway grades, crest/sag transitions and profile “templates” shall be designed in accordance with AS/NZS 2890.1 (current edition) and council's standard drawings. This includes providing sufficient transition lengths to control the algebraic change of grade at valleys and crests and to avoid vehicle underside “scraping” and towbar/overhang strikes.

Multiple driveways to each lot are discouraged and require specific approval. Where approved a maximum of 2 driveways may be provided with maximum width of 6.0 metres each. A secondary driveway will not be considered when:

- The lot is less than 20 metres wide.
- A reduction in the available room for on-street parking caused by the additional driveway is not desirable.
- Sight distance for the new driveway is limited because of a crest or curve in the road.
- The removal or relocation of one or more street trees, signs or other street furniture is required.
- The driveway is within 6 metres of the tangent point of the kerb return at intersections, as per AS/ NZS 2890.1:2004 and Council's DCP.
- The site is located on a classified road, and TfNSW have not consented to a second driveway.
- The driveway is otherwise constrained or not considered appropriate, as determined by Council.

For local roads with low travel speed, less than 50km/h, driver expectation of interference reduces the likelihood of conflict. Minimum Gap Sight Distance (MGSD) of 4s relative to the design speed must be available for vehicles entering or exiting from a property. The requirement to comply with MGSD will not apply to individual residential houses in built up areas.

Entrances to major developments such as shopping centres need to be analysed thoroughly to minimise their effect on the through traffic flow. The intersection of such accesses with the frontage road may be required to be treated the same as the intersection of two public roads.

10.2.3 Residential Battle-axe Driveways

In addition to items listed in 10.2.2 above, designs for battle-axe corridors for urban residential developments shall also include provisions for the following

- The continuation of the driveway into the main body of the lot to allow access to useable land either where the construction of that driveway later would impact on adjoining property or where topography, natural obstructions or poor ground conditions would make the driveway construction expensive.

- Unless a larger design vehicle is intended, the design vehicle for bends in driveway alignment shall be a single unit truck (medium commercial removalist vehicle). Pavement widths shall be increased to accommodate tracking of design vehicles with appropriate clearance offsets.
- In long and multiple user driveways passing bays shall be provided at appropriate intervals and at unavoidable blind crests, side roads and curves.
- Any requirements imposed in relation to fire either through the Building Code of Australia or in Bushfire Prone Areas, the NSW Rural Fire Services (such requirements may include controls on gradients, driveway widths, clearances and design vehicles for various travel paths).
- Completed works shall allow unobstructed routes for the future provision of private service pipes (where this cannot be achieved those services or appropriate conduits shall be installed in full as part of the works).

10.2.4 Multi-unit Residential, Commercial and Industrial Battle-axe Driveways

Battle-axe corridors for large residential, commercial and industrial developments shall be designed with jointed reinforced concrete, concrete pavers or clay pavers. Kerb will be required on at least one side of the pavement with one-way cross fall directed to this kerb.

In addition to items listed in 10.2.2 and 10.2.3 above, driveway designs shall also include provisions for the following:

- A pavement design, in accordance with an approved pavement design and/or report as outlined in Section 8.
- The grading of vacant areas within the corridor shall suit adjacent property levels at the boundary.

10.2.5 Rural Property Access

Treatment of access to rural properties is dependent upon several criteria including through traffic volumes, turning volume, design vehicle type, single or divided carriageway, land use and general topography.

The location for a point of access will be governed by the following:

- Sight distance.
- Median width/storage space (if available).
- Largest design vehicle to utilise the facility.
- Distance to intersection.
- Possible confusion with intersections.
- Deceleration/acceleration movements.
- Drainage and flooding.
- The existing and proposed utility services.
- Site restrictions.

There must be adequate sight distance for vehicles entering and exiting the property access. Stopping Sight Distance requirements for Hilltops Council regional and local roads are to be used. For State Highways, Safe Intersection Sight Distance shall be used. For all access

locations 2.5 sec Reaction Time (desirable) shall be provided. When this cannot be achieved, the minimum 2.0 sec Reaction Time is to be used.

Care must be taken to ensure sight lines are not affected by the location and height of roadside furniture, especially for accesses located on the inside of horizontal curves. Roadside landscaping, trees or structures are not to interfere with horizontal and vertical sight lines.

All rural accesses shall be designed in accordance with Austroads Guide to Road Design part 4: intersections and crossings – General, figures 7.2 to 7.4 (rural property access treatments) and Councils Engineering Guideline - Standard Drawings.

For access driveways serviced off unsealed roads, these driveways shall be of an unsealed all-weather construction.

Those new driveways serviced by sealed roads (Local/Regional/State), these shall be sealed from the bitumen road edge to the provided gate. A 14mm/7mm two coat seal is the minimum seal application required.

10.2.5.1 Rural Property Access Gate/Fence Setbacks

The following access gate setbacks also apply (for proposed or existing local road reserves of 20 metres wide) to rural subdivisions and developments:

- Equal to or less than 3 hectares – 5 metres set back from boundary line fronting the service road, subject to the width of the nature strip area (road shoulder edge to boundary) a modified set back distance will be stated in conditions.
- Greater than 3 hectares to less than 40 hectares - 15 metre setback from boundary to attain a 20-metre vehicle access from public road shoulder edge to gate, subject to the width of the nature strip area (edge of shoulder to boundary).
- Local Roads that are A-Double and B-Double approved shall have a gate setback of 32 metres and 28 metres respectively, from the road shoulder.

For State and Regional Roads:

- Up to 3 hectares – subject to TfNSW site specific comments
- Greater than 3 hectares to less than 40 hectares – Up to 30 metre vehicle access required from public road travel lane edge to gate, subject to TfNSW site specific comments.
- Equal to or greater than 40 hectares - Setback from boundary to attain a 30-metre vehicle access from public road travel lane edge to gate, subject to TfNSW site specific comments

Additionally, the Austroads Guide to Road Design also establishes the layout requirements including gate setbacks, minimum storage lengths for a single-unit truck clear of the traffic lane, indented access treatments where required based on the likely vehicles entering the development, sight distance requirements, and drainage treatments.

Longitudinal sections and cross sections (see 10.2) shall be provided for all rural accesses to demonstrate compliance with the above.

The design of the vehicle access crossing shall include provisions for the following:

- The driveway is to include, as applicable, table drain, gutter and path crossings in accordance with Council's Engineering Guideline - Standard Drawings.

- A pavement design in accordance with an approved Pavement Design Report.
- The continuation of the driveway into the main body of the lot to the vicinity of any approved building envelope.
- The driveway gradient on the approach to the road boundary shall comply with Council's Engineering Guidelines - Standard Drawings. Preference shall be given to a submitted design longsection drawing that illustrates compliance to Council's Guidelines.
- Where practicable, the design of driveway levels, crossfalls and batters to allow sheet flow to cross the driveway in a manner which does not cause any concentration of stormwater flow or erosion potential. Where sheet flow across the driveway may create a nuisance to adjoining properties or cause erosion, the collection and discharge of driveway stormwater runoff including runoff from uphill areas is required. Driveway runoff shall be collected and piped to the street drainage, Council drainage system or watercourse.
- Where the collection and discharge of driveway stormwater runoff is required, in part or in full, based on hydrologic and hydraulic calculations the driveway will be provided with standard profile gutters and kerbs, or formed shotcrete drains, or turfed drains (where grades < 8%).
- Any batters or earth retaining structures shall not restrict development over adjoining land or pose risks of instability or erosion.
- Any requirements imposed in relation to fire either through the National Construction Code or in Bushfire Prone Areas, the NSW Rural Fire Services (such requirements may include controls on gradients, driveway widths, clearances and design vehicles for various travel paths).
- Completed works shall satisfy cover and clearance requirements for any utility authority mains and installations.
- The future provision of private service pipes and poles must be considered.

10.2.6 Rural Residential Battle-axe Driveways and Internal Driveways

Battle-axe corridors for rural residential developments shall be constructed as a minimum of a sealed flexible road pavement.

In addition to items listed in 10.2.5 above, designs for rural battle-axe and internal driveways shall also include provisions for the following:

- The continuation of the driveway into the main body of the lot to allow access to useable land either where the construction of that driveway later would impact on adjoining property or where topography, natural obstructions or poor ground conditions would make the driveway construction expensive.
- Unless a larger design vehicle is intended, the design vehicle for bends in driveway alignment shall be a single unit truck whilst considering appropriate offset clearances. Pavement widths shall be increased to accommodate tracking of design vehicles.
- In long and multiple user driveways, passing bays shall be provided at appropriate intervals and at unavoidable blind crests, side roads and curves.
- Bitumen sealing is to provide all-weather access and to eliminate dust generated nuisance and prolong the integrity of the wearing surface/pavement.

10.2.7 All Weather Access in Private Property

The standard of roads over and within rural properties may vary depending primarily on:

- The intended duration, frequency and type of rural use.
- The route terrain and ground conditions.
- Risks to users, e.g. provision of safety barriers, type of surfacing for traction, flooding.
- Risks to the environment e.g. erosion, pollution, watercourse ecology, flood levels.
- Use for bush firefighting purposes and as fire escape routes.
- Construction difficulty, particularly achieving compaction and sealing on steep gradients.
- Maintenance considerations including the potential for obstruction of drainage pipes.
- As a guide, a road to a rural residence would require:
- The driveway access is to be all weather construction of a minimum depth of 200mm compacted road gravel.
- Where the access way connects to a sealed road the access way is to be bitumen seal as a minimum between the property boundary and the road carriageway.

All rural vehicle crossings shall include a reinforced pipe culvert, class 4, (to mitigate bush fire burn loss and accommodate a shallow pipe cover) unless the location of the property is at an obvious high point. A concrete dish crossing can be installed where the grade and depth of the road table drain cannot accommodate a pipe culvert.

All culverts shall have a headwall at each end of the pipe culvert. Driveable headwall shall be used wherever the culvert/headwall is located within the road safety hazard clear zone of the road (3-5 metres from road lane edge).

The minimum diameter of the pipe culvert shall be 375mm and pipes should be laid with the pipe invert 150mm below the invert of the table drain and is to have a minimum of 1 in 10 (10%) fall.

The minimum width of pipe culverts are 4.88 metres.

A concrete dish crossing will be considered when the verge dictates a cross fall of less than 1 in 10 (10%). The dish crossing is to be constructed in accordance with Councils Standard drawing.

Both sides of the access way are to be provided with guideposts, fitted with delineators, are located on the public roadside of the culvert. This delineation is to indicate both the culvert location and alignment for road users.

Other requirements are:

- A single lane minimum 4m wide flexible road pavement, table drains (pavement courses are extended to free drain into table drains), batters and provision for cross drainage.
- Passing bays provided at appropriate intervals and road widening at any blind crests, side roads and curves.
- Unless a larger design vehicle is intended, the design vehicle for bends in road alignment shall be a single unit truck. Pavement widths shall be increased to accommodate tracking of design vehicles.

- A single coat bitumen seal centrally aligned 3m wide. The pavement seal shall be widened to 6m at sections of road containing passing bays, widening for tracking and through blind crests, side roads junctions and curves.
- A pavement designed in accordance with an approved Pavement Design Report. A pavement report is to include details of any necessary subsurface drainage.
- High side grassed table drain developing into a lined drain where scour may become an issue.
- Low side provision for road runoff to sheet flow away.
- Cross drainage for standard property access shall be designed to convey the 20% AEP. Where the access is nominated or may reasonably be required to function as a bushfire evacuation or emergency egress route, the cross drainage shall be designed to convey the 1% AEP in accordance with Austroads Guide to Road Design and ARR2019. Depth indicators shall be installed as required by AS 1742. Where culvert capacity is exceeded, appropriate scour protection and spillways shall be provided to maintain structural integrity and safe passage.
- Cross drainage lines shall extend to the alignment of the table drain invert.
- Headwalls and associated rock protection shall be provided to cross drainage.
- The gradient on the approach to the road boundary shall comply with the relevant part(s) of AS/NZS 2890 Parking Facilities Set.
- Cut and fill batters shall be adopted for the ground conditions such as not to pose risks of instability.
- All cut and fill batters (and other remaining disturbed areas) shall be protected from erosion by vegetation.
- Any requirements imposed in relation to NSW Rural Fire Services (such requirements may include controls on gradients, driveway widths, clearances and design vehicles for various travel paths).
- Completed works shall satisfy cover and clearance requirements for any utility authority mains and installations.
- The future provision of any private service pipes and poles must be considered.
- Consider need or desirability of safety barriers, guideposts, reflectors and warning signs.

10.2.8 Non-standard Vehicle Access Crossings

A non-standard Vehicle Access Crossing (VAC) is a proposed VAC that is unable to be designed and constructed to AS/NZS 2890.1 Parking facilities: Off-Street car parking or Council's Engineering Guideline - Standard Drawings, due to topographical or physical restrictions affecting the site.

In steep locations where grades restrict the positioning of the VAC from commencing in the road at the proponent's property frontage, the following may apply:

- VAC may start from the formed road at the frontage of an adjoining or neighbouring property, as determined by Council.
- VAC constructed in the road may be further extended in the road to provide access for other properties not already serviced by a VAC, as determined by Council. In such

instances the maintenance and repair of jointly accessed VACs become the responsibility of property owners sharing the access.

Proposed VACs that are assessed generally as non-standard due to site constraints may require submission of plans of survey, cross section and longitudinal section details to enable Council to verify grades, crossfalls, access widths, structural details, drainage requirements or other issues to properly review the proposal.

Non-standard VACs are not recommended and are only considered by Council to facilitate access when there are no other feasible options and as such Council cannot take responsibility for the performance, risk/safety and liability arising from the approval and construction of a non-standard VAC, notwithstanding its reviewing role.

Plans and certification from a suitably qualified and experienced Civil or Structural Engineer are required as part of this process.

10.3 Car Park Design

10.3.1 Non-domestic Parking Areas and Design Standards

Non-domestic parking areas shall be designed applying the requirements of AS/NZS 2890 Parking Facilities Set as a minimum. The Designer shall consider but not be limited to:

- Design vehicles.
- Pedestrian, cyclists and persons with disabilities.
- Driveway widths.
- Parking bays and aisle dimensions.
- Driveway locations.
- Driveway and vehicle access crossing intersections with public roads.
- NCC fire requirements.
- Bushfire protection requirements.
- Drainage and flood impact.
- Landscaping/trees.

10.3.2 Design Vehicles

The design shall provide for all design vehicles expected to use the development.

Allowances for manoeuvres of commercial vehicles within the public roadway and in the entry driveway shall be appropriate for the vehicle's turning capabilities and frequency of servicing by those vehicles.

Access by inappropriate vehicles shall be constrained where practicable. Internally, vehicles shall be controlled by physical barriers and signs.

10.3.3 Layout Compliance

The layout shall be consistent with the approved development plan particularly in respect of:

- Fixed setbacks.
- Fixed aisle and parking bay geometry.

- Locations and treatment of entries and exits.

The layout shall address detailed building design matters including:

- Intrusion of structural components such as columns.
- Overhead intrusion of ramps and stairs etc.
- Ground clearance and headroom.

10.3.4 Travel Paths for Pedestrians, Cyclists and Persons with Disabilities

The design of internal driveways, paths and parking areas to be used by pedestrians, cyclists, delivery persons or persons with disabilities shall be appropriate for that usage. The designer shall consider and make provision for:

- Desirable travel routes.
- Protection measures for travel path users.
- NCC compliance.
- Facilitating use by persons with disabilities.
- Avoiding conflicts with travel paths of commercial vehicles or concentrations of cars.

10.3.5 Access Driveways

Access driveway layouts shall be appropriate for use by the types of vehicles accessing the development and with regards to the traffic and geometric characteristics of the public road.

Adequate sight distance shall be available for drivers leaving the site to vehicular traffic on the road and pedestrians on the path having regard as appropriate to the speed of vehicles on the road and the lane configuration of the road. Refer to 10.2 Vehicle Access to Properties.

10.3.6 Vehicular Control Points and Gates

Queuing areas shall be adequate for any vehicular control points and shall consider:

- User class.
- Road traffic volume.
- Entry/exit performance.
- Capacity of the car park.
- Parking turnover patterns.
- Control point operation.
- Provision for persons with disabilities.

10.3.7 Elevated Ramps and Ramps to Basements

The use of ramped sections of internal driveways and parking areas shall incorporate provisions for:

- Meeting acceptable gradients generally, at approaches to boundaries, control points and gates and as appropriate for use by persons with a disability where relevant.
- Appropriate alignment for the design vehicle usage.

- Achieving adequate sight distance for entering and emerging vehicle drivers.
- Separation of car parking bays from the ramp ends.
- Separation of any pedestrian crossing and informal pedestrian route from the ramp ends.

10.3.8 Vehicular Traffic Control

The use of road humps shall consider pedestrians, other modes of access and be appropriate for use in accordance with geometric requirements for:

- AS/NZS 2890.1 Parking Facilities: Off-Street car parking Type 1.
- AS/NZS 2890.1 Parking Facilities: Off-Street car parking Type 2.
- AS 1742.13 Manual of uniform traffic control devices: Local Area Traffic Management.
- Design of Road and Streets (DORAS).

10.3.9 Commercial Vehicle Manoeuvring

The design shall provide for travelling, turning, standing, reversing and other activities associated with the servicing of the development by commercial vehicles in respect of the following:

- Appropriate classes of design vehicles.
- Frequency of visits made by commercial vehicles.
- Allocation of service bays, service area aprons and the “service area” as a whole (i.e. the area of the development set aside for the manoeuvring, parking and loading or unloading of commercial vehicles for the delivery or removal of goods, freight or waste).
- Suitability of any area of the development in addition to the service area which shall be used by commercial vehicles in common with other vehicles.
- Conflicts with other vehicle travel paths.
- Avoidance of pedestrian travel paths.
- Turning circles including reversing while turning and swept travel paths.
- Loading/unloading operations.
- Roadway widths.
- Overhanging of medians, islands, landscaping.
- Mountable design of kerbs, medians, islands and roundabouts.
- Clearances to adjacent buildings and obstructions, lighting and signposting poles.
- Separation from pedestrians.
- Provision of signs and pavement markings to keep commercial vehicle travel paths separate from car parking.

10.3.10 Protection of Pedestrians

Adequate measures shall be provided to separate vehicular and pedestrian traffic including the use of:

- Kerbs or low barriers.

- Bollards.
- Handrails or fencing including childproof fencing.
- Pedestrian refuges.
- Kerb blisters in roadways.
- Marked pedestrian crossings.
- Grade separation using footbridges or underpasses.
- Alternative travel paths.
- Ramps in kerbs for prams, trolleys, wheelchairs and scooters.
- Separation of any pedestrian crossing and informal pedestrian route from the ends of vehicle driveway ramps.

10.3.11 Shopping Trolley Bay Locations

The locations of shopping trolley bays shall be considered at the detailed design stage regarding the following:

- Access to the bays shall at all times be clear of commercial vehicle manoeuvring areas and where practicable circulating traffic routes.
- The proximity must be open and well-lit for user personal safety and to enhance visibility of trolleys abandoned on the surrounding.
- Surface gradients must be minimal to allow ease of control of the trolleys.
- Surface drainage flows must be minimal so as not to discourage use of the bays in wet weather.

10.3.12 Bicycle Parking Facilities

The design of bicycle parking facilities and their access shall make provision for the following:

- Class of bicycle parking facility.
- Type and set out of parking rails and racks.
- Need for lighting.
- Need for weather protection.
- Specified clearances to pedestrian and vehicular traffic.
- General avoidance of immediate proximity to pedestrian doorways, attachments for blinds and awnings, pavement service access covers, street furniture, bus stops, loading zones, pedestrian crossings and areas over which car doors may be opened.
- Signs for locating and using the facilities.
- Security, access and ease of use for the relevant class of facility.

10.3.13 Pavement Surfaces

Pavement surface finishes shall be appropriate for roadways, accesses, pathways/footpaths, ramps including kerb ramps, parking area and loading dock pavements in respect of use by:

- Motor vehicles including motorcycles and motorised wheelchairs.
- Bicycles and wheelchairs.
- Pedestrians.
- Persons with disabilities.
- Persons with prams.
- Manual handling of goods.

The design shall provide for:

- Tactile ground surface indicators or tactile markers.
- Colour contrasting with their surroundings of tripping hazards such as kerbs, wheel stops and low barriers.
- Raised pavement markers specified shall not be greater than 3mm in height.
- Lipless kerb crossings for trolley access on main pedestrian paths.
- Physical controls or traffic management devices shall not obstruct or impede access or create a hazard on travel paths by reducing the available width to less than 1m or forcing unsafe manoeuvres.

10.3.14 Gradients for Pavement Areas

The grading of pavement areas shall comply with requirements for:

- Domestic driveways.
- Maximum gradients for vehicular traffic aisles.
- Maximum length wise gradients for car spaces.
- Maximum crossfalls for car spaces.
- Minimum gradients for pavement surface drainage.
- Minimum gradients for pavement edge drainage.
- Changes of gradients in driveways.
- Gradients at vehicular control points and associated queuing areas.
- Gradients in access driveways approaching boundaries.
- Gradients across paths.
- Where applicable maximum longitudinal gradients for cyclists, pedestrians, persons with disabilities and associated vehicles.
- Where applicable maximum crossfalls for cyclists, pedestrians, persons with disabilities and associated vehicles.
- Maximum gradients and crossfalls including superelevation for circulation roadways and ramps.

- Containment of shopping trolleys.
- Maximum gradients for special loading/unloading parking space.

10.3.15 Signs

Appropriate street signs shall be included for:

- Signifying car park entries.
- Signifying other entries.
- Warning of vehicles entering traffic.
- Warning of aged or disabled pedestrians or schoolchildren.

Appropriate signs shall be included within the site for:

- Controlling traffic movement and driver behaviour.
- Warning of hazards for vehicles or persons.
- Identifying sections or rows of car parking spaces.
- Identifying bus routes and lay-bys.
- Identifying enroute car, motorcycle and bicycle parking and roadway destinations.
- Directing pedestrians to travel paths, stairs, lifts and amenities and showing the layout of the development.
- Assisting persons with disabilities.
- Controlling noise, car lights or other environmental nuisances.

NOTE: All design drawings shall indicate that for all signs shown and approved for installation are to be supplied and installed by proponent with the exception of all road/street blade signs that are to be supplied and installed by Council at the cost of the proponent.

10.3.16 Landscaping

The landscaping design shall address:

- Instances where there is a need or likelihood that vehicles will overhang kerbs.
- Avoid the creation of obstructions that could affect the safe and effective use of parking spaces and or access points.
- Performance and sufficiency of street lighting and proposed development lighting.
- Adequacy of sight lines for vehicular traffic entering and exiting the development.
- Adequacy of sight lines for users of all internal travel paths.
- Visibility of signs.

10.3.17 Surface Drainage

The proposed stormwater drainage system and pavement grading shall prevent nuisance flooding of the pavement at:

- Areas of car spaces used to get into or alighting from vehicles.
- Main pedestrian and other travel paths.

- Kerb ramps.
- Approaches to pedestrian crossings.
- Approaches to intersections.
- Special loading and unloading spaces.
- Accessible parking spaces.
- Loading docks.
- Bicycle parking facilities.
- Taxi ranks and bus stops.
- Any area used by pedestrians or cyclists.

The proposed stormwater drainage system with the pavement grading shall prevent any flooding of the pavement at:

- Any building doorway or stairway.
- Any pavement or floor drained directly or indirectly to a sewer.
- Any vulnerable surface installation or pit containing machinery, electrical equipment, pipe inlet/outlet fittings or storage tank for the servicing the development.

10.4 Footpaths and Shared Paths

10.4.1 Design Standards and Guidelines

Footpaths and shared paths shall be designed with reference to, but are not limited to the following:

- AS 1742.10 Manual of uniform traffic control devices: Pedestrian control and protection.
- AS 1743 Road signs - Specifications.
- AS/NZS 2890 Parking Facilities Set.
- AS 3727.1 Pavements: Residential.
- Austroads Guide to Road Design, including Part 6A: Paths for Walking and Cycling.
- Relevant TfNSW Supplements.
- Council's Engineering Guideline - Standard Drawings.
- Council's Floodplain Risk Management Plans.
- NSW design of roads and streets (DORAS, TS 00066): street-type selection, cross-section allocation (furniture/buffer/clear-path/frontage zones), and crossing/priority principles. Designs shall be checked for consistency with the selected DORAS street-type and any departures shall be documented in the design report.
- Where applicable, NSW walking space guide and NSW cycleway design toolbox may be used to supplement Austroads/TfNSW detail.
- AS 1428 Design for access and mobility suite of standards.

10.4.2 Designing for Pedestrians and Mobility Impaired People

Consideration shall be given to designing for pedestrians and mobility impaired people in applicable aspects of the design of roads and road related areas, to address the requirements of the Disability Discrimination Act 1992 and AS 1428 Design for access and mobility: Part 1 General requirements for access - New Building Work.

Provision shall be made for the use of all public pathways by mobility impaired people.

Provision for use by mobility scooters shall be made where such use is likely or where required by an approval. Examples include access for aged care facilities, shopping centres and in passive recreation areas.

NOTE: Where a DORAS street-type is applied, footpath “clear path” widths and kerb-side buffer/furniture zones shall align with the relevant DORAS tables for the selected street context.

10.4.3 Paths in Road Reserves

New paths shall be minimum 1.5m wide (Shared Pathways 2.5m min.) and shall comply with Council’s Engineering Guideline - Standard Drawings.

Paths in road reserves must have a longitudinal grade the same as the roadway. Where grades exceed 15% special consideration shall be given to alternative access for pedestrians.

Crossfalls on paths shall be between 1% and 2.5% sloping towards the kerb, where practicable. At locations of existing vehicle crossings consideration to the methodology to match the existing structure is to be considered.

Consideration shall be given to the requirements of lot access, the volume and type of pedestrians and Service Authority requirements for existing and proposed utility services.

Kerb ramps shall be provided at road crossing points. Kerb ramps shall be designed and constructed in accordance with Council’s Engineering Guideline - Standard Drawings.

DORAS street-type consistency: Provide a kerb-side furniture/utility zone (for poles/trees/utilities), a continuous “clear path” pedestrian zone, and a frontage zone adjacent to property lines as per the relevant DORAS cross-section.

Continuous footpath treatment across minor driveways shall be used where the DORAS street-type indicates pedestrian priority (subject to as 2890.1 vehicle clearance and drainage).

Verge/berm grading shall target a desirable 4% crossfall toward the carriageway (where compatible with levels/accessibility) to enhance hydraulic performance.

10.4.4 Public Paths Not in Road Reserves

Public paths may be required to be constructed outside a road reserve to:

- Complete a path system.
- Be used in conjunction with an overland flow path. Refer to Council’s Engineering Guideline - Standard Drawings.
- Provide access to a specific facility.
- Facilitate a maintenance activity.
- Provide for recreational, scenic or tourist purposes.

Paths shall be shown on Design Drawings where:

- Nominated by an applicant as part of the development works.
- Required separately by conditions of a Development Consent.

The standard of design may vary depending on the volume and type of pedestrians expected, streetscape, public safety and other considerations. The requirement of Austroads Guides and AS 1428 publications shall be used when designing paths and any associated pedestrian bridges.

Path pavements shall be constructed in accordance with Council's Engineering Guideline - Standard Drawings.

Alternative details to Council's Standard Drawings may be required to cater for a particular circumstance. Approval from Council's Representative will be required. Refer to Section 8 - Design of Pavements.

The design of off-road paths may require consideration of matters not encountered in providing paving in formed road paths including:

- Catch drains to control uphill runoff.
- Protection of batters.
- Provision of handrails, barriers, fences or bollards.
- Cross drainage.
- Additional lighting.
- Public safety.
- Minimisation and facilitation of maintenance activities.

Where off-road paths connect back to a DORAS street-type, match terminal/interface treatments (e.g. Buffers, tactiles, hold lines, priority control) to the receiving street-type.

10.4.5 Public Pathways used as Overland Flow Paths

Pathways used as overland flow paths shall generally have:

- Preferred crossfall of 2.0% (2.5% maximum as dictated by AS).
- An integral 150mm kerb on the low side unless flows are of such a magnitude to warrant special treatment.
- Sufficient capacity to carry the flows with required freeboard.
- Velocity V depth flow criteria for safety to be in accordance with ARR 2019, in particular: Chapter 7 (Safety Design Criteria) within Book 6 (Flood Hydraulics).

Other forms of pathways for overland flow paths may be considered by Council. Concepts shall be discussed with Council's Representative prior to preparation of detailed designs.

10.4.6 Pathways used as Shared Bicycle Facilities

Where a public pathway is stipulated as a shared path, the applicable design requirements for cycleways and bicycle facilities shall be met.

10.4.7 Ramps and Stairs

The provision of stairs will only be permitted in steep sections of pathways where no reasonable alternative or ramp arrangement can be provided and the limitation of use of the pathway is accepted by Council's Representative.

Ramps more than 7% (14:1), other than paths adjacent to the road, and stairs shall be provided with handrails, tactile indicators and lighting unless otherwise approved by Council's Representative.

Specific design details including geometric and structural design shall be provided for ramps and stairs. Refer to Council's Engineering Guideline - Standard Drawings for details on concrete stairs.

10.5 Shared Paths, Cycleways and Bicycle Facilities

Consideration shall be given for cyclists in all aspects of road design and road related areas. Shared paths and other facilities such as cycle parking facilities shall be included in the design where specifically nominated in a Development Consent, Hilltops Council's Active Transport Plan (ATP), or other applicable documents.

Shared paths and bicycle facilities shall be designed in accordance with the requirements of Austroads publications and TfNSW Supplements. Issues not covered by Austroads publications shall be discussed with Council's Representative.

On Council local roads, proposals for shared paths and bicycle paths are to include:

- Any associated regulatory signs.
- Pavement markings or traffic control devices are determined by Council under the Authorisation and Delegation – Prescribed Traffic Control Devices and Regulation of Traffic (2025).
- WHERE a proposal meets the Condition 3 referral triggers (e.g., restricts/prohibits passage or compels/prevents turns for >6 months, or adversely affects public passenger services for >24 hours), it must be referred to the Local Transport Forum (LTF) for advice prior to Council's decision and tabled and minuted at the LTF.
- On State roads, written consent from Transport for NSW is required.

Where shared paths, cycleways and bicycle facilities are required, all related issues including the following shall be considered and detailed on the Design Drawings:

- Location, horizontal and vertical alignment.
- Width (2.5m minimum) and crossfall (increase width for regional and recreational shared paths).
- Sight distance.
- Drainage.
- Signs and pavement markings for pedestrians, cyclists and motorists.
- Vertical and lateral clearance to structures, top of embankments, hazards.
- Minimisation of projections into the cycleway (service pits, etc).
- Maintenance and access crossings. Thickening, reinforcing and highlighting of such areas.
- Provision of adequate safety railings, rub rails and barrier fences.

- Provision of shared path handrails at intersections and road crossings, where warranted.
- Need for the provision of lighting.
- Measures to ensure the distinctiveness of presence and continuity of cycleways, e.g. through changes in pavement types or character of the facility.
- Any identified need for path terminal treatments to deter or restrict motor vehicle access. Where this need is identified and approved by Council's Representative, terminal treatments shall be designed and installed in accordance with Council's Engineering Guideline - Standard Drawings.
- Align the selection of on-road vs off-road (separated/protected/shared) cycling facilities with the nominated DORAS street-type for the corridor. Show typical sections and nodes/intersections that match the DORAS solution.
- At intersections and driveways, apply DORAS consistent bicycle priority solutions (e.g. Protected intersections, priority crossings/set-back crossings, continuity surface treatments) in conjunction with TfNSW supplements.
- Where bus routes are present, resolve bus stop/cycleway interactions per DORAS street type (e.g. Bus boarder/bypass options) and document the selected treatment in the design report.
- Document any departures from the chosen DORAS street type (geometry, buffers, priority, crossing control) and provide safety/operability justification.

11 Stormwater Drainage Design

11.1 General

11.1.1 Introduction

This sub section is applicable to the design and documentation requirements for stormwater drainage systems for urban and rural areas. It covers hydrology and hydraulic design for a total stormwater drainage system including Water Sensitive Urban Design, principles of stormwater harvesting and re-use. Erosion and sedimentation control design is also included as it too relates to Stormwater drainage.

These specifications should be read in conjunction with Council's current Development Control Plan (DCP) and the latest version of Australian Rainfall & Runoff (ARR). In the event case of any conflict among these documents, the provisions contained within ARR will prevail.

It is expected that standard engineering practices on Hydraulics, Hydrology in urban drainage design will be adhered to.

Flood Studies and Floodplain Risk Management Plans adopted by Council and other relevant state agencies are available on Councils Website. Detailed flood level information for individual properties may be available from Council on request.

11.1.2 Design Life

All stormwater infrastructure is to have a design service life of 100 years. This applies to all pipes, pits and all structural elements. It is understood that natural/ naturalistic systems will be subject to natural impacts from weather and nature which are beyond the ability of the designer to account for. In respect of these elements of the stormwater system the above requirements regarding maintenance will apply.

11.2 Responsibilities

11.2.1 General Requirement

Provide design and documentation for stormwater drainage systems. Design Checklist is located under Appendix G of this document.

11.2.2 Standards

Standard: Conform to the current version of the following:

- Current version of Australian Rainfall & Runoff (ARR),
- Water sensitive urban design: To Engineers Australia, Australian Runoff Qualities (EAARQ).
- Hilltops Council Standard Drawings.
- Floodplain management to current edition of NSW Government Floodplain Development Manual.

11.3 Interpretation

11.3.1 Abbreviations

For the purposes of this sub section the following abbreviations apply:

- AEP: Annual exceedance probability.
- EY: Exceedances per Year.
- ARI: Average recurrence interval.
- GPT: Gross Pollutant Trap.
- IFD: Intensity-frequency-duration.
- HGL: Hydraulic grade line.
- OSD: On-site detention.
- SQID: Stormwater quality improvement devices.
- WSUD: Water sensitive urban design.

11.3.2 Definitions

For the purposes of this sub section the following definitions apply:

- Annual Exceedance Probability (AEP): The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.
- Average Recurrence Interval (ARI): The average or expected value of the period between exceedances of a given rainfall total accumulated over a given duration. It is implicit in this definition that the periods between exceedances are generally random.
- Catchment or Catchment Area: A topographically defined area drained by a stream where all outflow is directed to a single point.
- Catchment area of any point: The limits from where surface runoff will make its way, either by natural or man-made paths, to this point.
- Dual drainage: The major/minor approach to street drainage.
- Major system: The network of planned and unplanned drainage routes providing safe, well defined overland flow paths for rare and extreme storm runoff events. It includes roads, natural channels, streams, culverts, community retention/detention basins and other facilities.
- Minor system: The gutter and pipe network capable of carrying and controlling flows from frequent runoff events. It includes kerb and channels, inlet structures, open drains and underground pipes and on-site detention facilities.
- National Water Quality Management. Strategy (NWQM S)
- Primary treatment Stormwater Quality Improvement Devices (SQID): Removal of the majority of gross pollutants and coarse-medium grained sediments by screening or sedimentation, e.g. GPT's, trash racks, sediment trap.
- Redevelopment site: A site that had (or was originally zoned to have) a lower density development than is proposed.

- Secondary treatment SQID: Removal of the majority of coarse, medium and fine grained sediments, as well as a significant proportion of the pollutants attached to sediments, by enhanced sedimentation and filtration, e.g. infiltration basins and wet ponds.
- Stormwater management plan: A plan to manage the stormwater quantity and quality within a catchment or a development and protect receiving water features, such as the protection of existing waterways, lakes and wetlands.
- Sub-catchment: A topographically defined area drained by a tributary or branch drain of a primary stream, river or main draining catchment.
- Tertiary treatment SQID: Removal of the majority of sediments attached pollutants and dissolved pollutants by sedimentation, filtration and biological uptake, e.g. constructed wetlands.
- Time of concentration: The time required for storm runoff to flow from the most remote point on the catchment to the outlet of the catchment or to the inlet of a drainage structure within the catchment.
- Treatment train: Sequencing of SQID's to optimise treatment performance.
- Trunk drains: Flow $\geq 1\text{m}^3/\text{s}$ for 1% AEP event.
- Water Sensitive Urban Design (WSUD): Design principles aimed at improving the sustainable management of the urban water cycle. It integrates the planning and design of urban water cycle, water supply, wastewater, stormwater and groundwater management, urban design and environmental protection.
- Water Course: watercourse consists of a stream with a bed, with banks, and water. That the flow of the water in the stream is intermittent or seasonal will not prevent what would otherwise be a watercourse from being accounted such: but though it is quite true that a watercourse may exist though its bed be dry for some periods, the watercourse must exhibit features of continuity, permanence and unity. It must essentially be a stream and be sharply distinguished from a drainage depression in the contours of the land which serves to relieve upper land of excess water in times of major precipitation, such a drainage depression will lack banks and a bed in the proper sense of that term, that is to say, identifiable margins of a continuous and permanent stream which contribute to its unity whether or not water is in fact continuously flowing over the bed.

11.4 Pre-design Planning

11.4.1 Land Use Planning

- Refer Council's DCP for restrictions related to flood affected land.
- Refer Councils Local Environment Plan (LEP) for land zoning and flood affected land.
- Refer existing flood and risk management studies for flood affected land in the council website.

11.4.2 Stormwater Management

Integrate management activities at the catchment, waterway and local development level in conformance with the NWQMS Document 10 and the following:

- Restore existing stormwater systems.
- Minimise the impacts of stormwater from new developments.

- Hydrological: Minimise the impacts of urbanisation on the hydrological characteristics of a catchment including wet weather and low flows. Mitigate pre-development inappropriate flows where practical.
- To stabilise landform, control erosion and sediment.
- Water quality: Minimise the amount of pollution entering the stormwater system and remove residual pollution by implementing stormwater management practices.
- Vegetation: Maximise the value of indigenous riparian, floodplain and foreshore vegetation.
- Aquatic habitat: Maximise the value of physical habitats to aquatic fauna within the stormwater system.
- Processes for management: Implement processes for management for the following as applicable:
 - Runoff.
 - Water quality.
 - Riparian vegetation.
 - Watercourse and aquatic habitat.
 - Urban bushland.
 - Bridges and culverts across waterways.

Water Sensitive Urban Design (WSUD): Plan and design stormwater drainage using WSUD principles including the following:

- OSD.
- Capture and use of stormwater as an alternative source of water to conserve potable water.
- Use of vegetation for filtering purposes.
- Water-efficient landscaping.
- Protection of water-related environmental, recreational and cultural values.
- Localised water harvesting for re-use.
- Localised wastewater treatment systems.

11.5 Consultation

11.5.1 Council and Other Authorities

Consult with the Council and other relevant authorities during the preparation of design. In addition to the requirements of this sub section, identify the specific design requirements of these authorities. e.g. DPIE, NSW Fisheries, Transport for NSW.

11.5.2 Utilities Service Plans

Existing services: Obtain service plans from all relevant utilities and other organisations whose services exist within the area of the proposed development by contacting Dial Before You Dig (DBYD). Plot these services on the relevant drawings including the plan and cross-sectional views. Location of subsurface utilities: To AS 5488.1 and AS 5488.2.

11.5.3 Calculations

Certified design calculations: Engage a qualified and well experienced hydrologic and hydraulic design Professional Engineer to perform all required calculations. All plans to be supported by hydraulic calculations.

11.5.4 Major Structures

Certified structural design: Engage a Professional Engineer for all bridges, major culvert structures and specialised structures.

11.6 Design Criteria – Stormwater Drainage Systems

11.6.1 Overall Design

11.6.1.1 Flooding

- Reduced frequency of flooding of private and public buildings in flood-prone areas.
- Nil increase in flood levels on any other properties downstream. Refer Councils DCP – Flood Liable Land.
- How system functions and stability of major structures in the event of a PMF (PMF only required for sensitive development as defined in the Floodplain Development Manual).
- Impacts as a result of increased rainfall due to climate change.
- Appropriate Blockage Factors & Freeboards.
- Control of surface flows to prescribed velocity/depth limits.
- Control of surface flows to minimise the effect on pedestrians and traffic in more frequent stormwater conditions.
- Retention of incident rainfall and runoff consistent with the planned use of the area, within each catchment.
- Conformance with the current ARR major/minor system concept.
- Minimising impacts of flooding both upstream & downstream.
- A high level of safety for all users.
- Acceptable levels of amenity and protection from the impact of flooding.
- Ensure that the design capacity of downstream drainage systems are not compromised.
- Minimise construction and maintenance costs and avoid the need for future property acquisition.
- Ensure low maintenance and economically sustainable in the long term in relation to operation, maintenance and replacement costs.

11.6.1.2 Climate Change Considerations

Climate change considerations are important in the design of an asset or structure depending on the design life. A risk assessment is required as described in the current version of ARR, "Climate Change Considerations" Book 1 Chapter 6.

Current ARR Recommendations for Target Design Years:

- Short-term projects (2021-2040): Use near-term (2030) scenario – temporary structures.

- Medium-term projects (2041-2060): Use medium-term (2050) scenario.
- Long-term projects (2081-2100): Use long-term (2090) scenario – subdivision and Councils civil works.

Designers shall consider SSP2 for design purposes, and conducting a sensitivity analysis that also considers SSP3 for a conservative or adaptive approach. This shall be demonstrated in the design calculations. It is also advised that the designer shall use the Recommended Current (2030) baseline rainfall data as a starting point for the modelling and the information from the Australian Climate Futures website developed by CSIRO.

Depending on the sensitivity of the project, the design life of the asset and the consequences of failure, projected climate rainfall can be used as part of a sensitivity and risk assessment. Based on that assessment, scenarios such as **SSP2-4.5** or **SSP3-7.0** should be considered.

The following is also to be noted:

- Highly sensitive projects would be retention basins and stormwater systems designed upstream of existing or zoned urban development.
- Asset design life for stormwater is 100 years.

11.6.1.3 Water Quality

- NorBE – Neutral or Beneficial Effect.
- Adoption of WSUD principles.
- Opportunity to improve water quality.

11.7 Design for Stormwater Harvesting and Re-use

Design for re-use of locally generated roof water, stormwater.

Stormwater re-use scheme: Design the re-use scheme for ease of operation and maintenance. Consider the following when designing for collection, storage, treatment and distribution:

- End use requirements for water quality and quantity.
- Reliability of supply.
- Estimated demand for water with regard to peak flow.
- Assessment of water balance for sizing and storage.
- Storage requirements considering average annual volume and diversion flow rates.
- Treatment system based on:
 - Diversion flow rates before storage.
 - Distribution flow rates both before and after storage.

11.7.1 Roofwater

Provide an integrated design with rainwater tanks, coordinate with the appropriate engineering consultation and conform to Statutory and local authority requirements.

11.7.2 Stormwater Runoff

Design for the utilisation of stormwater runoff at the following scales:

- Allotment scale.
- Subdivisional/regional scale.

11.7.3 Stormwater Collection Requirements

- Extraction of sufficient water to meet the end use requirements without compromise to downstream aquatic eco systems.
- Ability to stop collection in the event that stormwater is contaminated by an incident within the catchment.
- Minimisation of the risk and/or impact of upstream flooding.

11.7.4 Stormwater Storage Requirements

- Storage of sufficient water to balance supply and demand.
- Minimisation of mosquito habitat, risks to public safety and risks to water quality in above ground storage.
- Maximisation of dam safety.

11.7.5 Stormwater Treatment Requirements

- Minimisation of public health risks for the adopted public access arrangements.
- Minimisation of environmental risks.
- Mitigate Pollution run-off.

11.7.6 Stormwater Distribution Requirements

Minimise the potential for:

- Contaminant inputs downstream of the final treatment facilities.
- Public exposure to untreated stormwater.
- Cross-contamination with mains water distribution networks or confusion with mains water supplies.

Irrigation: Design the irrigation system to the following requirements:

- Minimise run off, groundwater pollution and soil contamination.
- Minimise spray to areas outside the access control zone to reduce public health risks, if access control is adopted.
- Application rate of stormwater: Uniform for the irrigation scheme and less than the nominal infiltration rate to avoid surface runoff.

11.8 Hydrology

11.8.1 Design Rainfall Data Requirements

- Design IFD: Available from ARR Data Hub and BOM websites. www.data.arr-software.org/

- ARR2019 AS/NZS 3500.3 Appendix E.
- Bureau of Meteorology IFD tool website www.bom.gov.au.
- Geoscience Australia website www.ga.gov.au.
- Record IFD: Document the adopted IFD data used in the hydrological calculations to the sample summary sheet.

11.8.2 Additional Requirements

- Austroads AGRD05.
- Record AEP: Document the adopted AEP data in the hydrological calculations to the summary sheet
- Design Average Exceedance Probability (AEP). For design under the "major/minor" concept, the design AEPs/EYs are given below in the Table 7:

Table 7: Land Use Type and AEP/EY

Land Use Type		
Minor System	Annual Exceedance Probability Design Storm (AEP) %	Exceedances per Year (EY)
Urban Residential minor system	20	0.2 EY
Urban Residential – interallotment drainage minor system	10	
Urban Residential (medium to high density) see * note below.	10	
Business/Commercial/Industrial Minor Systems.	10	1 EY
Hospitals, Retirement Villages/Homes, Schools and Hospices.	10	
Parks & Recreation areas		1 EY
Rural Developments Minor Systems	20% AEP to 1% AEP (Council may consider variations to the design AEPs)	0.2 EY
Overland Flows (Major)		
Velocity X Depth (pedestrian)	0.40 m ² /s for 1% AEP	

Land Use Type

Minor System	Annual Exceedance Probability Design Storm (AEP) %	Exceedances per Year (EY)
Velocity X Depth (trafficable)	0.60 m ² /s for 1% AEP	
Overland flow paths and trunk drainage general.	1% AEP	
Road Culverts/Pipes		
Culvert (Urban)	10	
Culvert (Regional or State Highway)	5	

*Note * unless specified by TfNSW.*

The following information must be noted while designing urban drainage using 2019 rainfall and the loss models:

- Loss Model: Initial and Continuous.
- For urban drainage design in accordance with ARR'19, the equivalent impervious area (EIA) of the total impervious areas can be guided from the following Table 8.

Table 8: Approximate Equivalent Impervious Area Values

Catchments	EIA %
Urban Subdivision drainage	70%
Car Parks	90%
Road	85%
CBD areas	80%

IMPORTANT NOTE: The actual impervious areas should be determined. The above figures are a guide only.

11.8.3 Catchment Area

Catchment definition: To Austroads AGRD05A clause 2.6.3. If detailed survey is not available, determine the extent of the catchment area from current topographical mapping, aerial photographs or field survey.

Site inspection: Verify catchment boundaries, flow paths and existing drainage infrastructure by site inspection.

Catchment area land use: Establish catchment area land use based on current available zoning information.

Record: Document the design to the Catchment areas plan.

Extent: The catchment area for a particular point is defined by the limit from where surface run-off will make its way, either naturally or by constructed overland or piped paths, to this point. Consideration shall be given to changes to individual catchment areas due to the full development of the catchment. Determine the extent of the catchment area from current topographical mapping, aerial photographs or field survey.

Flow paths to pits shall be representative of the fully developed catchment considering such things as fencing and the likely locations of buildings and shall be shown for each collection pit on the catchment area plan. Consideration shall be given to likely changes to individual flow paths due to the full development of the catchment.

Roughness co-efficients ' n^* ' (not Manning's n) to be used in Kinematic Wave Equation to calculate time of concentration shall be derived from reliable publications values applicable to specific zoning and land use types, referencing Table 9.

Table 9: Land Use Roughness Coefficients

Land Use Type	Roughness ' n^* '
Flow across parks	0.35
Rural residential	0.30
Residential (2a)	0.21
Residential (2b)	0.11
Industrial	0.06
Commercial	0.04
Paved surfaces (clay or concrete)	0.012
Asphalt/sealed roads, Gravel areas	0.02

11.8.4 Methods of Analysis

Flows: Determine in conformance with the current ARR and the requirements of this sub-section.

Flow studies: Prepare flow studies including the following:

- A relevant range of AEPs for each sub-catchment.
- Calculation of total flows at junctions of existing drainage works.
- Assessment of allowable flows from catchment/sub-catchments for release to downstream areas or drainage systems.
- Assessment of release from detention storages affecting capacity of drainage works to avoid surcharge/inundation.

- AS/NZS3500.3 clause 5.4.6.

Record: Document details of adopted AEP's, temporal patterns, latitude/longitude of the subject catchment. Equivalent Impervious Areas, adopted initial and continuing loss.

Time of concentration: For urban areas, use kinematic wave equation, consider the limitations in relation to slope and flow path length, area: Sufficient modelling to determine the critical storm for the catchment.

Flow time: If the flow path passes through areas having different flow characteristics or includes property and roadway, calculate the flow time of each portion of the flow path separately.

Flow paths to pits: Document the flow path for each collection pit for the fully developed catchment on the catchment area plan. Consider the following:

- Fencing.
- Potential locations of buildings.
- Changes to individual flow paths due to the full development of the catchment.
- Proposed detention works.

Manning's roughness co-efficient ('n') for specific zonings:

- ARR 2019
- Austroads AGRD05A Table 5.3.

Modelling:

- Model type required for design: Preferred use of "DRAINS" or similar software for urban situations. "XPRAFTS" software for rural situations can be utilised and will consider the use of other models as appropriate.
- Submit details of all program input and output.
- Submit copies of the final data files.

11.8.5 Alternative Models and Computer Analysis

General: Use of other hydrological models or computer analysis is permitted. If using alternative models or computer analysis, conform to the following:

- Satisfy the requirements of the current version of ARR.
- Submit summaries of calculations.
- Submit details of all program input and output.
- Submit copies of the final data files.

11.9 Hydraulics

11.9.1 General

From Councils Insurer Statewide Mutual Guidance Note - Stormwater Infrastructure document, the opening background statement sums up the broad objectives of this section.

"Society's attitude towards development, and the impacts of development, has changed over recent decades. The effects of development are now more critically evaluated. As a result, legislation and standards have been established identifying minimum requirements for

development. This process is ongoing and in the case of stormwater management it is now expected that the stormwater discharging from a development area will have no greater impact than runoff from the area prior to development”

The document also notes;

“Many existing commonly provided stormwater facilities have created a range of risk exposures that may not have been considered or anticipated at the design or approval stage. This highlights the connection between asset management and risk management and the importance of evaluating the ongoing whole-of-life implications arising from the provision of stormwater drainage facilities.”

The broad objectives of best practice and this section are to:

- Convey stormwater to receiving waters with minimal damage, danger & nuisance
- Stabilise landform and control erosion
- Enhance the urban landscape, whilst maximising land available for urbanisation
- Maintain the water quality of receiving waters by removing contaminants
- Minimise stormwater flooding
- Manage the drainage system in an environmentally sustainable manner
- Promoting stormwater elements as part of the urban form.

Developers of land are to be wholly responsible for disposing of all storm water runoff which passes over or through the respective properties, roads and reserves.

Under common law, a person may not concentrate or direct the runoff into an adjacent property. The downstream property must not be subjected to an increase in runoff above the previously undeveloped runoff.

The development is required to accept runoff from uphill properties and provide adequate drainage facilities to manage the uphill natural runoff.

Stormwater objectives are considered as being achieved when the following applies:

- Planning, design and construction of new facilities is adequate to service new and future developments consistent with both the engineering, environmental, asset management and planning best practice.
- There is compatibility with existing facilities, operational methods and maintenance techniques.
- Facilities provide adequate environmental, community and asset protection consistent with accepted design and construction requirements set out in this document and with developments in technology as approved from time to time.
- Whole-of-catchment-based approach for design is taken.

The Designer is to provide a design report that sets out the basis for the design of stormwater drainage (stormwater quantity). This should include explanatory text including all relevant assumptions and input parameters, together with supporting tables and diagrams, sufficient for Council’s Representatives to confirm the adequacy of the design without the need to obtain further information. Although the onus is on the Designer to provide sufficient information in the design report, there will be some cases where Council’s Representatives will stipulate specific information to be included in the design report.

11.10 Design Philosophy

In preparing stormwater drainage designs, Council requires use of the latest edition of Australian Rainfall and Runoff: A Guide to Flood Estimation (ARR 2019). Where it is necessary to provide a full reference for ARR, the following description should be used: =Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors), 2019, Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia.

The following restrictions shall apply when preparing stormwater drainage designs:

1. Use of the Probabilistic Rational Method to determine peak discharges on rural catchments is not permitted.
2. Use of the urban Rational Method with the hydraulic grade line approach (HGL), as outlined in ARR 1987, is not permitted.

Other current Australian published design guides, for example Austroads Guides, and Australian Standards may also be applied to particular design situations. Design parameters specified in ARR 2019 shall be used, unless agreed with Council's Representative to use alternative parameters. Design parameter recurrence intervals are shown below in Table 10 for reference.

Major/minor drainage concept: To current ARR and Austroads AGRD05A.

11.10.1 Minor System

Minor System: The underground and surface elements that carry frequent, nuisance-level storms includes:

- Kerb and gutter flow within the normal roadway width
- Pits, pipes and small channels
- Any overland flow contained within the road reserve that does not cause property flooding

Purpose: To prevent inconvenience and local ponding during regular rainfall events and keep roads trafficable.

Note: In accordance with ARR 2019 and Austroads AGRD05A, controlled surface bypass flow along kerb and gutter is permitted in the design minor storm, provided the flow remains within the carriageway, does not exceed pedestrian or vehicular hazard limits, and is directed to the next inlet or designed overland flow path.

Criteria:

- The design of the minor system shall take full account of existing downstream systems and flows from upstream catchments.
- The subdivision design shall make provision for the disposal of stormwater from individual sites in such a way as not to cause a nuisance or damage to any other properties.
- Interallotment drainage must be provided for the properties that cannot discharge to the road drainage. The design AEP and other aspects to be determined in consultation with the development engineers and as detailed in this Design guideline.

11.10.2 Major System

The combination of natural and constructed overland flow paths that safely convey infrequent, larger storms includes:

- Streets, reserves, flow paths, floodways, and open channels
- Detention basins, culverts, levees, and other trunk infrastructure

Purpose: To ensure that when the minor system is exceeded or blocked, runoff is safely conveyed without causing inundation of buildings or endangering life.

Table 10: Design Annual Exceedance Probabilities with Blockage Factor

Drainage Situation	Minor System	Major System
Residential streets and catch drains with overflow or bypass along the street	20% AEP	1 % AEP 1% AEP flood to be confined to carriageway. Consider depth / velocity ratio for safe vehicular and pedestrian access
Residential streets and catch drains at low points with overflow along public reserves and pathways	20% AEP	1 % AEP 1% AEP flood to be confined to carriageway, pathway or reserve Consider depth / velocity ratio for safe vehicular and pedestrian access
Existing residential streets and catch drains at low points with drainage lines traversing building allotments or other locations where surface flow may cause property damage	20% AEP generally, 1% AEP if no escape route	1 % AEP A 50% blockage factor is to be applied to the adopted minor underground drainage system. The extent of the 1% AEP flood is to be shown on the plans so that appropriate easement width and treatment of escape route can be determined. Headwall trash racks shall be provided to avoid blockage from debris.
Trunk system traversing developed areas (residential, commercial or industrial) Trunk systems are those having catchment areas in excess of 15ha or having 100-year ARI runoffs in excess of 3m ³ /s whichever is the lesser.	N/A – Not a minor System	1 % AEP A 50% blockage factor is to be applied to the adopted minor underground drainage system. The extent of the 1% AEP flood is to be shown on the plans so that appropriate easement width and treatment of escape route can be determined. Headwall trash racks shall be provided to avoid blockage from debris.

Drainage Situation	Minor System	Major System
Commercial / industrial and business areas	10% AEP generally, 1% AEP if no escape route	1 % AEP A 50% blockage factor is to be adopted for the underground drainage system. The extent of the 1% AEP flood is to be shown on the plans so that appropriate easement width and treatment of escape route can be determined. Headwall trash racks shall be provided to avoid blockage from debris.

The probability of design flood events is to generally be described in terms of the Annual Exceedance Probability (AEP), as discussed in Chapter 2 (Fundamental Issues) within ARR 2019 Book 1 (Scope and Philosophy). The previously used terminology Average Recurrence Interval (ARI) is not encouraged. Given that ARI terminology has in the past been used extensively, the Designer is referred to Figure 1.2.1 in Chapter 2 of Book 1 for a comparison of AEP and ARI for different event probabilities.

An AEP/ARI comparison for frequencies in the range 63.21% to 0.1% AEP (1-year to 1000-year ARI) is shown below in Table 11.

Table 11: EP/ARI Comparison

1	63.21% AEP is equivalent to 1-year ARI (1)	7	5% AEP is equivalent to 20-year ARI
2	50% AEP is equivalent to 1.44-year ARI	8	2% AEP is equivalent to 50-year ARI
3	39.35% AEP is equivalent to 2-year ARI (1)	9	1% AEP is equivalent to 100-year ARI
4	20% AEP is equivalent to 4.48-year ARI	10	0.5% AEP is equivalent to 200-year ARI
5	18.13% AEP is equivalent to 5-year ARI (1)	11	0.2% AEP is equivalent to 500-year ARI
6	10% AEP is equivalent to 9.49-year ARI (1)	12	0.1% AEP is equivalent to 1000-year ARI

Note 1: For practical purposes in day-to-day practice, the 60%, 40%, 20% and 10% AEP events are taken to be equivalent to the 1-year, 2-year, 5-year and 10-year ARI events respectively.

For events more frequent than 50% AEP, expressing frequency in terms of AEP is not particularly meaningful since AEP is constrained to a maximum of 100%. For example, a 1-month ARI has a 99.999386% AEP and a 3-month ARI event has a 98.168436% AEP. Consequently, events more frequent than 50% AEP should be expressed as 'X' Exceedances per Year (EY). For example, 12 EY and 4 EY are equivalent to 1- and 3-month recurrence intervals respectively and more meaningful than their AEP equivalents.

An EY/ARI comparison for the more common frequencies in the range 12 EY to 1 EY (1-month to 1-year ARI) is shown below in Table 12.

Table 12: EY/ARI Comparison

1	12 EY is equivalent to 1-month ARI	4	3 EY is equivalent to 4-month ARI
2	6 EY is equivalent to 2-month ARI	5	2 EY is equivalent to 6-month ARI
3	4 EY is equivalent to 3-month ARI	6	1 EY is equivalent to 1-year ARI

For determining design rainfalls, particular attention is to be given to the following chapters in ARR 2019 Book 2 (Rainfall Estimation):

- Chapter 3 (Design Rainfall) - refer in particular to Section 3.9 (Application).
- Chapter 5 (Temporal Patterns).

The approach to temporal patterns has changed considerably in ARR 2019 to account for the significant variability in temporal patterns between rainfall events of similar magnitude, and the effect differing patterns can have on peak flow estimates. This has led to the concept of modelling an ensemble of temporal patterns to account for the variability of patterns. Hence for each AEP of interest, using multiple temporal patterns for each storm duration results in a range of peak discharges (or volumes) at each duration - when multiple results are graphed for each duration this presents as a 'duration box plot' as shown in Figure 2.5.17 in Chapter 5 (Temporal Patterns) of Book 2 (Rainfall Estimation).

When assessing temporal patterns using ARR 2019, the Designer is to be cognisant of the following matters:

1. Temporal patterns derived by the regional burst approach are recommended for general use.
2. The use of an ensemble of 10 temporal patterns at each duration is recommended to appropriately represent the variability in observed patterns.
3. If 10 temporal patterns are not available for a given region, duration and frequency then patterns can be taken from other similar regions.
4. When selecting a small ensemble of temporal patterns, it is important to capture the typical variability of the observed events.
5. Testing of large numbers of ensemble patterns show results tend to cluster around the mean and median, which should be preferred in design. Generally, temporal patterns representing the worst (or best) case are not suitable for design.
6. Where two-dimensional hydraulic model run times are excessive using 10 temporal patterns (for multiple durations), the pattern closest to the average is likely to be suitable. Alternatively, doubling the grid cell size will decrease run time eightfold.

7. Using an ensemble of 10 temporal patterns provides a range of plausible answers. The Designer should also consider the benefits of investigating a larger number of temporal patterns with a Monte Carlo simulation for sensitive designs and solutions.

Where appropriate for a particular catchment, the design rainfall assessment is to also consider the following chapters in ARR Book 2:

- Chapter 4 (Areal Reduction Factors).
- Chapter 6 (Spatial Patterns of Rainfall).

The following approaches in ARR 2019, which were not available in ARR 1987, are to be used where circumstances warrant:

1. Regional Flood Frequency Estimate Method can be used to estimate peak discharges on small to medium rural catchments - refer to Chapter 3 (Regional Flood Methods) within Book 3 (Peak Flow Estimation). NOTE: Alternatively, and for larger catchments, flood hydrograph approaches are applicable - refer to Chapter 6 (Flood Hydrograph Modelling Approaches) within Book 5 (Flood Hydrograph Estimation).
2. Blockage of Hydraulic Structures - refer to Chapter 6 (Blockage of Hydraulic Structures) within Book 6 (Flood Hydraulics).
3. Safety Design Criteria for people, vehicles and buildings - refer to Chapter 7 (Safety Design Criteria) within Book 6 (Flood Hydraulics).

The stormwater drainage design for new subdivisions shall be based on a Flood Study undertaken previously by a suitably qualified professional as deemed appropriate by Council's Representative where available.

All designs shall be calibrated to the current flood study where applicable which is available on request, the NSW SES Local Flood Insights tool or the NSW Governments Flood Data Portal.

- The major system shall be via an overland flow path or a combination of overland flow and flow through pipes.
- Onsite detention or other solutions including downstream drainage augmentation may be required to ensure that development does not have adverse impacts on downstream drainage infrastructure and public safety.
- The major system shall be designed where the capacity of minor system is exceeded. The major system shall be designed to cater for 1% AEP storms applying appropriate blockage.
- Major systems shall be designed considering appropriate blockage in accordance with Report 11 Engineers Australia (www.arr.ga.gov.au/revision-projects/project-list/projects/project-11)
- Hydraulic structures Allowance shall be made for the resultant afflux, and the resultant surcharge flows shall be accommodated within overland flow paths.
- Surcharging of drainage systems will not be permitted for storms 0.2 EY or below. For storms greater than 0.2EY may be permitted across the road centreline where the road pavement is below the natural surface of the adjoining private properties.
- The velocity X depth product of flow across the footpath and within the road reserve shall be such that safety of children and vehicles is considered. The maximum allowable depth is 0.2m and the maximum velocity X depth product of 0.4m²/s.

For vehicles:

- Maximum velocity X depth is $0.6\text{m}^2/\text{s}$.
- In open channels the above velocity X depth product criteria will be followed where possible, or the design shall address the requirements for safety in relation to children by providing safe egress points from the channel or other appropriate methods.

Council's Engineering Guideline - Design Guideline shall be read in conjunction with the associated Construction Specification and Council's Policies and Plans relating to flooding.

11.10.3 The Major/Minor Stormwater Systems

The provision of stormwater drainage consists of a pipe system for controlling nuisance flooding (minor system) combined with a continuous overland flow path or floodway system (major system) to accommodate less frequent flood events and flows in excess of the minor systems. The major/minor concept may be described as a 'system within a system' for it comprises two distinct but conjunctive drainage networks.

All new urban development shall be provided with a major drainage system designed with sufficient capacity and freeboard to ensure that flood flows up to 1% Annual Exceedance Probability (AEP) do not encroach upon private land.

The major drainage system typically consists of the arrangement of pavements, roadway reserves, engineered flow paths and waterways, detention basins, flood protection levees, and major cut-off drains planned to convey a design flow up to 1% AEP in conjunction with the available capacity of the minor drainage system.

11.10.4 Provision for Failure

If failure of stormwater drainage system components occurs during periods of extreme rainfall, the risk to life and property could be significantly increased.

It is important to ensure that the combined major/minor system can safely cope with reasonable surcharge due to blockages and flows in excess of the design AEP.

In establishing the layout of the pipe network, Designers shall ensure that surcharge flows will not discharge onto private property during flows up to and including 1% AEP. For flows in excess of 1% AEP, Designers shall ensure that the likelihood of nuisance flooding or damage to private properties is considered, minimised and the likelihood of catastrophic consequences are considered and averted.

All stormwater detention basins and ponds that meet the definition of a prescribed dam under the Dams Safety Act 2015 shall be assessed in accordance with the requirements of Dams Safety NSW (DSNSW) and the Dams Safety Regulation 2019. The full assessment shall be submitted to Council and referred to DSNSW where applicable.

11.10.5 Natural Drainage Paths

The major and minor drainage systems shall be planned and designed to conform to natural drainage patterns and discharge to natural drainage paths in the catchment. If the Designer deems that natural drainage paths require modification to accept the higher peak flows resulting from urban development, the Designer shall seek advice from Council's Representative before proceeding with the drainage design.

Runoff must be discharged from a development in a manner that will not cause adverse impacts on downstream property, stormwater systems and natural watercourses or become a source of hazardous material.

In general, runoff from development sites within a catchment shall be discharged at the existing natural drainage outlet(s). If the Designer wishes to change discharge points or apportionment of catchment flows between discharge points, they must demonstrate that the change will not have unacceptable adverse impacts on downstream properties or stormwater systems.

Discharge total from a development is **NOT** to exceed the predevelopment peak flow. Control by detention is expected where this exceedance occurs.

11.10.6 Surface Flows

Surface flow safety criteria must be applied to minimise both nuisance flooding and major hazards from flooding of roadways, buildings and other areas that have regular public access. Refer to the latest edition of Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia and the Queensland Urban Drainage Manual for further guidance.

11.10.7 Interallotment Drainage

Interallotment drainage **SHALL** be provided for every allotment which does not drain directly to its street frontage and for high side properties fronting roads with either kerb unable to satisfactorily accommodate kerb outlets, or where carriageways have one-way crossfall. Interallotment drainage shall be deep enough to serve the entire allotment; property inlets shall be constructed at the low corner of each lot in accordance with Council's Engineering Guideline - Specification - Standard Drawings. Refer to Section 11.18 Interallotment Stormwater Drainage of this Design Guideline for further details.

11.11 General Requirement for Developments

The level of runoff control required is dependent on the type of development proposed. Flow control requirements are stipulated for the following:

- New developments.
- Redevelopment of existing sites.
- Augmentation of existing stormwater systems.

11.11.1 New Developments

Each new development shall be considered individually regarding existing and proposed drainage systems, location in the catchment and other matters relating to stormwater.

Generally, it can be expected for new development proposals that, the post-development peak flow from the outlet point(s) of the site to the downstream public drainage system or receiving water shall not exceed the pre-development peak flow for both the major and minor system design storm AEP. Pre-development peak flow shall be the estimated flow from the site based on known or estimated catchment conditions prior to the new development.

To reduce peak outflows, the stormwater system may be provided with flow attenuation measures such as infiltration devices or detention basins and/or the compensating augmentation of existing drainage systems.

Design storm AEPs for the major and minor drainage systems shall be selected in accordance with Section 11.12.2 Design Annual Exceedance Probability of this Design Guideline.

The provision of additional stormwater infiltration, retarding, detention, storage or other control facilities may be required by Council after consideration of relevant stormwater drainage analysis and concept plans required as part of the development application documentation.

11.11.2 Redevelopment of Existing Developed Sites

Each redevelopment proposal shall be considered individually regarding existing and proposed drainage systems, alteration or abandonment of existing infrastructure, location in the catchment and other pertinent matters. Preferred treatment of abandoned infrastructure is removal of the disused asset. Other options shall be approved by Council's Representative.

Redevelopment includes land redevelopment and subdivision redevelopment. Land redevelopment is the redevelopment of single lots or multiple adjacent lots where all the stormwater system will be privately owned. This includes both Unit and Dual Occupancy developments. Subdivision redevelopment is redevelopment where all or parts of the stormwater system will become part of the public drainage system.

Generally, it can be expected for redevelopment sites that, the post-redevelopment peak flow from the outlet point(s) of the redevelopment site to the existing downstream public drainage system or receiving water shall not exceed the pre-redevelopment flow for both major and minor system AEP.

The pre-redevelopment peak flow shall be the estimated flow from the site based on the development conditions (including any existing flow attenuation facilities) prior to redevelopment. The degree of runoff control required will depend on the scale of the development and the net change in impervious area. Flow control will be required for any redevelopment where the density (measured as the total equivalent impervious area) of the redevelopment is greater than that of the existing development.

The stormwater drainage design for redevelopment site is to ensure that the redevelopment does not create or worsen any capacity problems in the existing public drainage system. This will generally require the construction of on-site and/or off-site public detention/retention systems and/or the compensating augmentation of existing drainage systems.

The major and minor system design storm AEPs referred to shall be those appropriate for the existing development in accordance with Section 11.12.2 Design Annual Exceedance Probability of this Design Guideline. Note that these are the AEPs that the existing public drainage system must have been designed for, not the as-constructed capacity of the system.

The requirements for the provision of stormwater retarding, detention, storage or other control facilities shall be determined by Council's Representative after consideration of relevant stormwater drainage analysis and concept plans required as part of the development application documentation. Augmentation of Council's existing drainage system may be considered in lieu of on-site detention systems, subject to approval by Council's Representative.

11.11.3 Stormwater System Augmentation

Stormwater system augmentations are undertaken in existing urban catchments to alleviate flood hazards due to under-capacity major and/or minor drainage systems. The main objectives for such augmentation works shall improve flood protection for land and to increase pedestrian safety and vehicle stability on roadways.

The potential to increase the flow carrying capacity of existing roadways is usually limited.

To achieve the objectives of the stormwater drainage augmentation it may be necessary to increase the AEP capacity of the minor drainage system above that specified in Table 11 13 Major/Minor System Design in order to ensure that:

- The 1% AEP “gap flow” on roads (refer to Section 11.12.2 Design Annual Exceedance Probability) meets the surface flow criteria limits.
- Overland flow from storms up to and including the 1% AEP is not discharged through easements over private land on the low side of road verges, particularly at steep T-intersections and trapped road low points.

11.11.4 Stormwater Inlet and Outlet Discharge

The following requirements shall apply to the design of system inlets and outlets:

- Where no Council drainage system exists, the maximum permissible site discharge from a development/lot to either the kerb and gutter or table drain shall be up to 25L/s at any one discharge point. Discharge points shall be at least 15m apart.
- For other than single residential or dual occupancy developments, Council's Representative shall confirm the maximum discharge that will be allowed to discharge into the street surface drainage system.
- Design of all inlets and outlets shall ensure that there are no adverse impacts arising from any changes of upstream and downstream water surface levels, flow velocities and flow direction.
- The Designer shall design for scour protection at inlets and outlets to suit local conditions. Consideration shall be given to current best practice. Detailed design calculations shall be provided to support the need for and type of energy dissipation devices.
- The Designer shall design inlets and outlets with due diligence, considering public safety requirements based on a risk assessment methodology. Refer to the latest edition of Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia and the Queensland Urban Drainage Manual for further guidance.
- At points of discharge of gutters or stormwater drainage lines or at any concentration of stormwater from or to adjoining properties, Council will require the Service Provider to enter into a Deed of Agreement with the adjoining owner(s) granting permission to the discharge of stormwater drainage and the creation of any necessary easements with all costs being met by the Service Provider prior to development approval.
- Where the drainage is to discharge to an area under the control of another statutory authority e.g. the Crown or Public Works, the design requirements of that Statutory Authority shall be met.
- Stormwater drainage systems discharging to or through reserves, if permitted under the relevant plan of management, shall be taken to a natural watercourse and discharged through an approved outlet structure or alternatively taken to the nearest stormwater line. All works shall be subject to detailed design. The creation of easements may be required.

11.11.5 Landscaping and Stormwater Infrastructure

The following landscape requirements are intended to ensure that the stormwater drainage system will enhance an area while ensuring that tree planting does not result in flooding or tree root intrusion problems.

Tree planting must be restricted within 3m of a stormwater drainage system, except in the case of tree planting in street verges. Vigorous rooting tree species shall not be planted within 10m of a stormwater drainage system. Where a drainage system passes near or under existing mature trees, consideration shall be given to the use of an alternative alignment.

Allowance shall be made for the effects of landscaping in the hydraulic calculations of floodways and engineered waterways. Approval from Council's Representative is required for the design factors used.

The design of landscaping shall also consider any increased frequency and the facilitation of maintenance of the stormwater system infrastructure.

11.11.6 Maintenance

The stormwater drainage system shall be designed to be readily and economically maintained. Allowances for maintenance including adequate and stable access for maintenance machinery shall be detailed in the design.

Designs incorporating the need for special or unusual equipment must not be prepared without the prior approval of the Council. This approval also extends to the use of special techniques or the hire of special equipment.

The Designer shall refer to Council's Representative for specific maintenance requirements for situations not covered by this document.

11.12 Hydrology

11.12.1 Design Principles

Design methods and data for urban drainage shall be based on ARR 2019, as amended:

- Chapter 6 (Flood Hydrograph Modelling Approaches) within Book 5 (Flood Hydrograph Estimation).
- Book 9 (Runoff in Urban Areas).

For catchment areas greater than 50 hectares, two recognised flow estimation methods shall be used for comparative purposes.

Design methods for internal drainage of developments and improvements within a single allotment shall generally be in accordance with the most current version of AS/NZS 3500.3 Plumbing and drainage: Stormwater drainage and the National Construction Code: Volume 3 (PCA).

11.12.2 Design Exceedance Probability (AEP)

The following provisions also apply to adoption of the design AEP:

- Design AEP for shared paths and bridges shall be consistent with Austroads design guides.
- Analysis carried out by the Designer shall in any instance consider the possibility of property damage or danger to life that might occur in specific situations outside the recommended design AEP.
- Major overland flow paths within developments such as pathways or roadways shall cater for the 1% AEP event minus 50% of the minor flow (piped system, e.g. 20% AEP, see above). This is generally referred to as the "gap flow".

- Trunk (Major) drainage is excluded from the above “gap flow” design procedure and shall cater for the 1% AEP flow within the drainage structure and provide a secondary flow path that will cater for a 50% blockage.

In addition to the above, where a development is designed in such a way that the major system flows involve surcharge across private property, the underground system (both pipes and inlets with designated blockage factors) shall be designed to capture and contain 1% AEP flows from the upstream catchment. An emergency overland flow path shall also be provided for these systems with a nominated discharge volume or percentage of the 1% AEP flow.

Easements shall be provided in private property over such pipe systems and overland flow paths. Restrictions shall also be placed on the property so as not to permit changes in surface levels or the construction of certain structures within these easements.

11.12.3 Impervious Area Assumptions

11.12.3.1 Minimum Lot Design Impervious Fraction

The following minimum design impervious percentages shall be used for design purposes unless alternative percentages which are based on site specific details of a proposed development are justified. Justification shall be provided to, and approval shall be sought from Council’s Representative.

The minimum design impervious percentage for single residential lots shall be:

- 85% for lots 450m² and smaller.
- 80% for lots 450m² to 700m².
- 75% for lots greater than 700m².

The minimum design impervious percentage for other lot types shall be:

- 5% for non-urban lots.
- 90% for medium and high density residential.
- 95% commercial or industrial developments.

11.12.3.2 Composite Areas

For modelling of urban catchments, sub-catchments are typically composite areas that include land, road reserves and open space areas, etc.

The Designer shall assess whether the adoption of typical values shown in Table 13 are 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. For values different to those in Table 13, justification shall be provided to, and approval shall be sought from Council’s Representative.

Table 13: Composite Impervious Area Guidelines

Type of Development	Design Impervious Area (%)
Single Residential Lot Subdivisions	80
Multi-Units	90
Commercial and Service Trades	95
Group and Neighbourhood Shopping Centres	95
Town Centres	95
Industrial	95

11.13 Road Drainage

11.13.1 Road and Street Network

Urban road stormwater drainage systems are required to operate in an effective manner with minimal maintenance requirements. The following provisions shall apply to road drainage design:

- Gutters shall be provided for all kerbs where pavement areas drain to the kerb.
- Adequate pipe and pit inlet capacity shall be provided such that surface flows up to the minor system design AEP are drained from the surface.
- Consideration must be given to the placement and location of pit inlets to minimise potential driveway conflicts and to adequately intercept surface water from steep grades. This particularly applies where a steep side street intersects a cross street at a T-intersection, and before kerb returns commence, i.e. at tangent points.
- The design of vehicle access crossings across the verge must take account of water flowing in the street. The verge and vehicle access crossing/driveway profile must maintain a positive grade for sufficient distance behind the kerb to avoid road flows in excess of the pipe system capacity up to the 1% AEP level from entering adjacent land.
- The use of high inlet capacity pits (0.5m³ /sec) must be avoided wherever possible.
- Grate only inlet pits will not be permitted except in carriageways with narrow verges or no verges and where a kerb inlet type sump would conflict with other services.
- A cul-de-sac which falls toward the head shall have an overland flow drainage reserve from the low point in the head to ensure that flows in excess of the capacity of the pipe system, up to 1% AEP, do not cause flooding within properties. The verge shall be shaped to direct overflows to the drainage reserve.

11.13.2 Surface Flow Criteria

Surface flow criteria must be applied to minimise both nuisance and hazardous flooding conditions on roadways. The criteria shall comprise three basic limits, depending on the road lane configuration and the design storm AEP as follows:

- Flow width limit.
- Pond or flow depth limit.
- Flow velocity x depth limit (for stability of pedestrians and vehicles).

Kerb flow widths may be estimated in accordance with the procedure contained in Australian Rainfall and Runoff: A Guide to Flood Estimation, Queensland Department of Main Roads (Australia) methods, or using various drainage software programs.

11.13.2.1 Surface Flow Criteria for Roads in Minor Storm Flow

Adopting the 20% AEP flood as that arising from the design minor storm of the same Annual Exceedance Probability, flow width criteria are shown in Table 14, Figure 3 and Figure 4.

Table 14: Surface Flow Criteria for Roads in Minor Storm Flow

Minor System Flow (20% AEP)		
Situation Code	Situation Description	Surface Flow Limit
a	Two lanes (or more) in the same direction plus parking lane	The inside and any lane-locked lanes clear plus 2.5 m clear width in the remaining lane i.e. water kept out of the wheel paths of lanes
b	Two lanes (or more) in the same direction	The inside and any lane-locked lanes clear plus 2.5 m clear width in the remaining lane
c	One lane plus parking lane	Water is not allowed to spread past the edge of the through lane
d	One lane plus shoulder	A minimum clear width of 2.5 m is to remain in the lane
e	At medians	2.5 m clear width in the traffic lane next to the median
f	At intersections without left slip lanes	The allowable width of spread adjacent to the kerb is 1.0 m
g	At intersections with single left slip lanes	The allowable width of spread leaves 2.5 m clear width in the slip lane
h	At intersections with dual left slip lanes	The allowable width of spread leaves 2.5 m clear in outer turning lane
i	For road of lesser importance, in situations where it is difficult to achieve the required clear width of 2.5 m in cases (b), (e) and (h) above	The clear width may be reduced to 1.0 m. This practice is not recommended for reasons of consistency, and the use of a reduced clear width must be specified in design brief and/or contract documents or approved by Council's Representative

Minor System Flow (20% AEP)

Situation Code	Situation Description	Surface Flow Limit
j	Where pedestrians will cross the road	No more than 0.5 m width of spread (100% AEP flow). Where risk of injury is reasonably foreseeable, velocities must be limited by: $d_g V_{avg} \leq 0.4 \text{ m}^2/\text{s}.$ Where: d_g = flow depth in the channel adjacent to the kerb (m), and V_{avg} = average velocity of the flow (m/s).

(Source: Adapted from Queensland Road Drainage Manual Chapter 11, 2015)

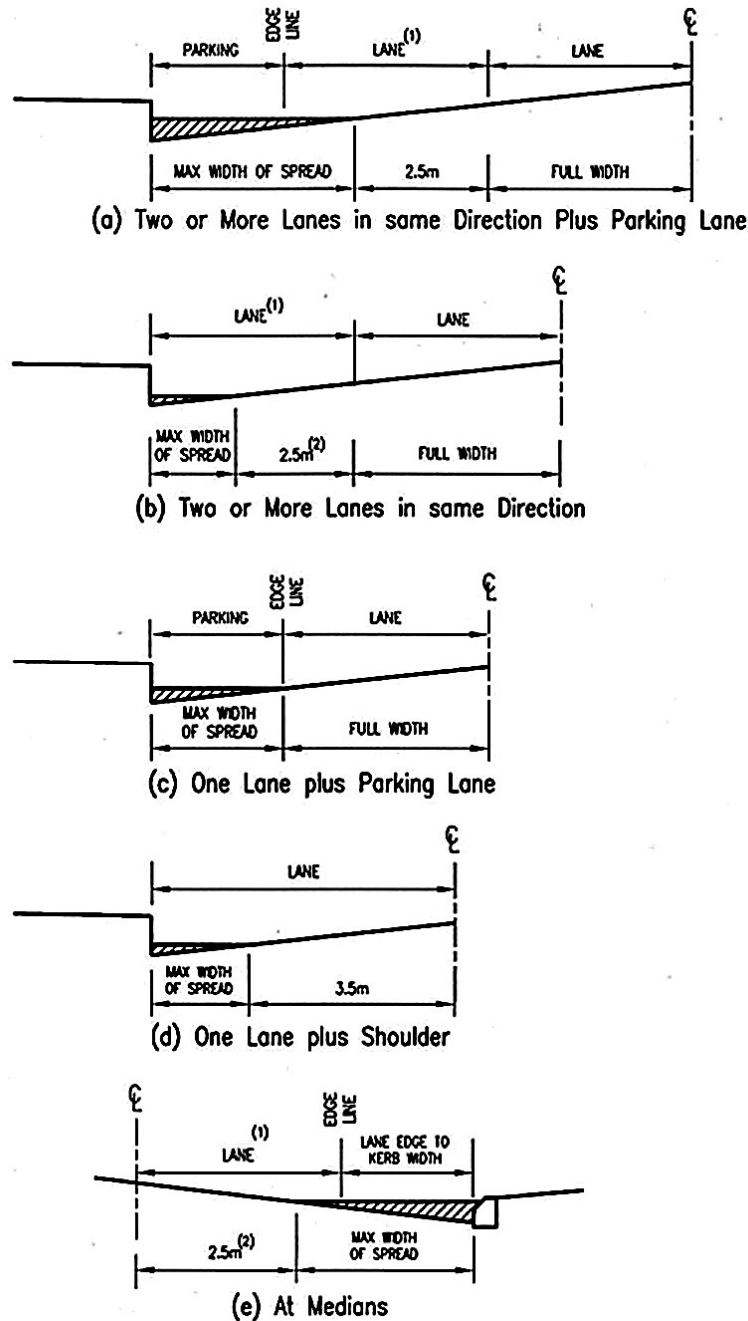


Figure 3: Allowable Flow Widths on Roadways – 20% AEP Flood (cross section views)

Notes:

1. Lane includes auxiliary lanes and any parking lane that has the potential in the future to become used as a through lane for full or part time.
2. In situations where it is difficult to achieve the required clear width of 2.5m, the clear width may be reduced to 1.0m for roads of lesser importance (refer Table 14 above).

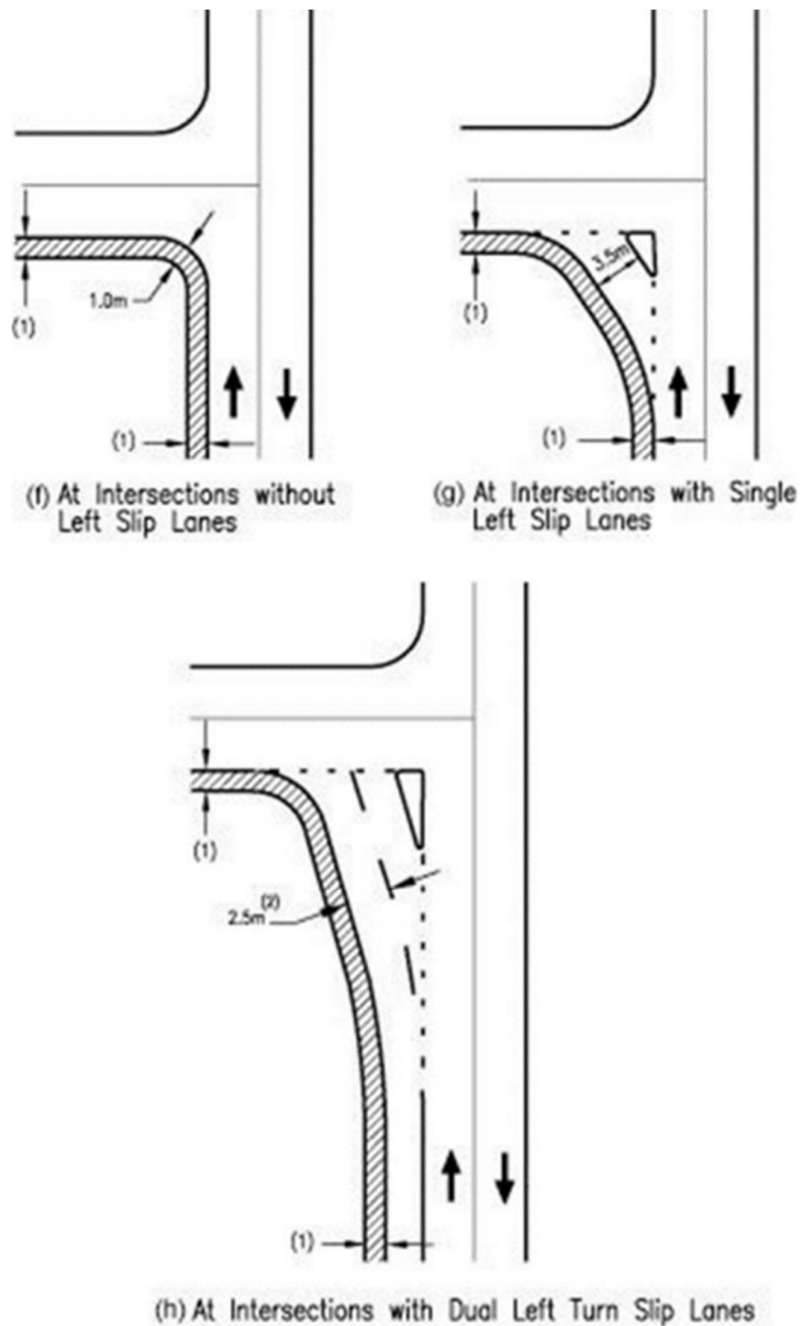


Figure 4: Allowable Flow Widths on Roadways – 20% AEP Flood (plan views)

Notes:

1. Refer to Figure 3
2. In situations where it is difficult to achieve the required clear width of 2.5m, the clear width may be reduced to 1.0m for roads of lesser importance (refer to Table 14).

3. At pedestrian crossings check both width and velocity (refer to Table 14).
4. See Section 11.13.2.2 for allowable widths in Major Storms.

11.13.2.2 Surface Flow Criteria for Roads in Major Storm Flow

The 1% AEP flood must be used as the major storm flow for consideration of any detrimental effects.

Table 15 below gives roadway flow limits for a major storm, with particular reference to floor levels of adjacent buildings, pedestrian and vehicle safety.

At sags in State-controlled roads, additional inlets and underground drainage must be provided, if necessary, to limit ponded water in a 2% AEP storm so that there is:

- One lane in each direction of travel, free of water, in a multi-lane road; or
- Width of 3.5m clear of water down the centre of a two-lane road.

Concurrence from TfNSW will be required regarding hydraulic modelling/design about State highways.

Table 15: Surface Flow Criteria for Roads in Major Storm Flow

Major System Flow (1% AEP)		
Situation Code	Situation Description	Surface Flow Limit
K	Where floor levels adjacent building are above road level	Total flow contained within road reserves. Peak water levels at least 300mm below floor level of adjacent building (i.e. freeboard of at least 300mm)
L	Where floor levels of adjacent building are less than 350mm above top of kerb • Where fall on footpath towards kerb is greater than 100mm • Where fall on footpath towards kerb is less than 100mm Where no kerb is provided	Water depths to be limited to 50mm above top of kerb. 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.
M	Pedestrian safety # a) No obvious danger b) Obvious danger	$d_g V_{avg} \leq 0.6 \text{m}^2/\text{s}$ $d_g V_{avg} \geq 0.4 \text{m}^2/\text{s}$
N	Vehicular Safety	Maximum energy level of 300mm above roadway surface for areas subject to transverse flow.

Major System Flow (1% AEP)

Situation Code	Situation Description	Surface Flow Limit
Note: d_g = flow depth in the channel adjacent to the kerb i.e. at the invert (m) V_{avg} = average velocity of the flow (m/s) # Obvious danger is interpreted as areas where pedestrians are directed to or most likely to cross water paths (such as marked crossings and corners of intersections).		

11.13.3 Major Traffic Routes

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 AEP, consideration shall be given to making the drainage for the two systems compatible to address any potential system surcharging issues.

Additionally speed zoning influences hydraulic safety for roadways. Concurrence from TfNSW will be required regarding hydraulic modelling/design about State highways.

11.13.4 Protection Drains

Carriageways in cuttings and cut batters must be adequately protected from runoff originating beyond the limits of the road. This protection will generally be cut-off drains or dished gutters. Major Drainage Crossings (e.g. bridges, culverts, etc) over major floodways and natural waterways shall be designed with reference to AS(NZS) 5100:2017 Bridge Design Series; Austroads Guide to Bridge Technology - Set; and Austroads Guide to Road Design - Drainage Set.

Unless a full blockage analysis is undertaken in accordance with Chapter 6 (Blockage of Hydraulic Structures) within ARR 2019 Book 6 (Flood Hydraulics), the following shall apply:

- Waterway crossings with end elevation diagonal measured openings equal to or less than 6m, shall be designed for 50% blockage - applied from the bottom up, where applicable.
- Larger waterway openings shall be designed for 20% blockage - applied from the bottom up, where applicable.

11.13.5 Pedestrian Underpasses

Pedestrian underpasses 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 1% AEP capacity.

Where an underpass is part of an engineered waterway, the free draining underpass drainage system shall be designed for a 20% AEP. The level of footpaths and/or cycleways shall be above the 40% AEP flood level in the engineered waterway. A floodway advisory sign shall be provided on each approach to the underpass.

11.14 Stormwater Drainage Systems

11.14.1 General Stormwater Drainage Conduit Requirements

Stormwater drainage conduit types shall be in accordance with the requirements of Council's Engineering Guideline - Construction Specification Section 6.2 Acceptable Materials for Stormwater Pipes and Box Culverts.

Reinforced concrete is the preferred material for stormwater drainage systems. The use of polypropylene (PP) pipe materials is acceptable for pipe systems up to 600mm diameter in urban interallotment drainage systems only. It is not to be used in applications in the road reserve as a council asset, or used under access driveways. Proposals for the use of other materials shall be referred to Council's Representative for consideration.

The minimum pipe size shall be nominal 375mm diameter. The minimum internal dimensions of any box culvert in a Council drainage system shall be 600mm width and 300mm depth.

All pipes proposed for use shall be manufactured, supplied and used in accordance with relevant Australian Standards.

Pipes need to be capable of resisting subsidence, root intrusion, hydraulic pressure, soil and construction loading, and have some flexibility at joints. Pipe jointing types shall be as required by Council's Engineering Guideline - Construction Specification.

The maximum allowable pressure head for all pipes shall be in accordance with the appropriate Australian Standard and the manufacturer's specifications for use.

11.14.2 Locations and Alignments

11.14.2.1 Roadway Reserves

The longitudinal alignment of pipes and culverts in roads shall be located under the kerb alignment and the back outside face of the pipe or culvert shall not extend behind the back of the kerb.

The alignment of standard grated gully pits with extended kerb inlet shall comply with Council's Engineering Guideline - Standard Drawings.

Straight drainage alignments are preferred. However, curved alignments may be permitted with approval of Council's Representative (refer to Section 11.21.12 Curved Pipelines).

11.14.2.2 Private Land

New stormwater systems through existing private land must be avoided. However, where such works cannot be avoided, the Designer shall refer the proposed design to Council's Representative for review before completion of the design.

Generally, a stormwater system shall not be located within proposed private land, except where it is intended solely for the purpose of providing interallotment drainage. Stormwater systems shall be located such that access for maintenance and future upgrades can be readily achieved and restrictions imposed on the use of the land via easements due to the presence of the stormwater system are minimised.

Generally, no buildings or overhanging structures are permitted over Council's stormwater drainage system, to enable access and maintenance and to ensure that any required overland flow path is not impeded, particularly by debris blockage, unless specifically approved by Council's Representative.

Wherever stormwater systems are required along common boundaries, they must be located along the low side of the uphill property.

Stormwater systems proposed to be constructed in parallel to sewers shall generally be shallower than the sewer to facilitate future connections.

Where a proposed development abuts undeveloped land, which has the potential to be developed, the possibility of shared stormwater drainage shall be considered as it is undesirable to maintain unnecessary parallel drainage systems. Co-ordination of stormwater drainage to avoid future doubling up of services shall be discussed with Council's Representative.

Alignments shall be offset sufficient distance from building lines to allow working room for excavation equipment, and all excavation trenches shall be outside the zone of influence of any structures.

11.14.2.3 *Public Lands*

Proposals to locate stormwater systems within public land such as open space shall be brought to the attention of the Council's Representative. Alignment of stormwater systems on public lands shall be located with consideration to public safety, maintenance access and future land use.

11.14.2.4 *Clearance from Other Services and Utilities*

Minimum clearances have been established to reduce the likelihood of damage to stormwater systems or other services and utilities, and to protect personnel during construction or maintenance work. Refer to Council's Engineering Guideline - Construction Specification.

Under no circumstances shall stormwater systems be:

- Locally deflected from their proposed alignment to avoid other services, utilities or other obstacles.
- Located longitudinally directly above or below other underground services or utilities in the same trench.

Where a stormwater system crosses or is constructed close to an existing service, potholing shall be undertaken to confirm depth, alignment and asset details at the design stage. Design documentation shall instruct the Service Provider to confirm the location and level of the existing services prior to constructing the proposed stormwater system.

Minimum clearances between stormwater systems and other underground services and utilities shall be in accordance with requirements specified by the service or utility asset owner.

It is the Designer's responsibility to obtain the current minimum clearances from each service or utility asset owner. The required minimum clearances shall be clearly stated on the Design Drawings so that the Service Provider is able to confirm that the required clearances can be achieved.

Where a stormwater system will be located within close proximity to another service, the Designer shall ensure that the requirements of the relevant Authority and WSAA code are met, and the estimated clearance is clearly labelled on the Design Drawings.

Stormwater systems shall be designed such that maintenance and future upgrades can be performed without the risk of inadvertent damage to the assets of other Authorities.

11.15 Gross Pollutant Traps (GPT) and Sediment Traps

11.15.1 General

GPT/sediment trap location:

- Determine location and catchment size in conformance with EAARQ clause 8.4 and the following:
 - Vehicular access for maintenance.
 - Available space.
 - Proximity to pollutant source areas.
- Outlet approach: Use a single device to treat a whole catchment (up to 200ha or more).
- Distributed approach: Target smaller individual catchments with many traps.
- Site constraints: Including topography, soils and geology, groundwater, space, access, odour problems, visual impacts, safety concerns and vermin.

GPT/sediment trap performance and type:

- Performance: To EAARQ clause 8.5 including the following:
 - Treatment objectives:
 - Gross pollutants: Remove litter and vegetation larger than 5mm.
 - Sediment: Remove particles larger than 0.125mm.
 - Remove 90% of all material greater than 0.125mm.
 - Operating design flows: 4EY (98.17 % AEP, 0.25 ARI).
 - Flood capacity: Analyse hydraulics of the drainage system including the headloss of the GPT and diversion weir under flood conditions. Review the design of the bypass system for impacts on the local drainage system and consequences on flooding.
 - Trapped pollutant storage: Assess the pollutants that are likely to be collected and determine the holding capacity with respect to 4 times per year cleaning frequency.
- Maintenance requirements: Design the GPT for maintainability and operability including the following considerations:
 - Ease of maintenance and operation.
 - Vehicular access to the GPT site.
 - Frequency of maintenance.

Assessment of GPT performance:

- Include in the maintenance program requirements for validating the GPT performance by field monitoring, physical laboratory models or computer simulation.

Selection of the GPT: To the EAARQ Appendix 8A checklist and the following:

- Life cycle costing.
- Retention volume sine of the unit in relation to 4 cleanings/year.
- Footprint and depth of the unit.

- Occupational health and safety.

Hydrocarbon management:

- If required, design and size water/oil separators or interception devices in conformance with EAARQ clause 9.7.

11.15.2 Constructed Wetlands and Ponds

General Treatment process:

- Determine in conformance with EAARQ clause 12.3 and the following:
 - Sedimentation.
 - Filtration.
 - Adsorption.
 - Biological uptake.
 - Pollutant transformation.
 - Pollutant storage.

System design:

- Design the system in conformance with EAARQ clause 12.4 and 12.5 including the following:
 - Hydrological effectiveness: Quantify the effects of the interaction between the following:
 - Volume of the detention system.
 - Hydraulic capacity of the outlet structure of the system.
 - Variability of runoff inflow to the system.
 - Hydraulic efficiency: Control the flow patterns for uniform distribution throughout the system to provide optimal treatment on the inflow.
 - Notional detention time: Select the design detention period.
 - Depth of permanent water in the wetland.
 - Provide with a GPT at the inlet.
 - Select wetland vegetation, fish or fauna.

An example of a sediment trap/constructed wetland is shown below in Figure 5.

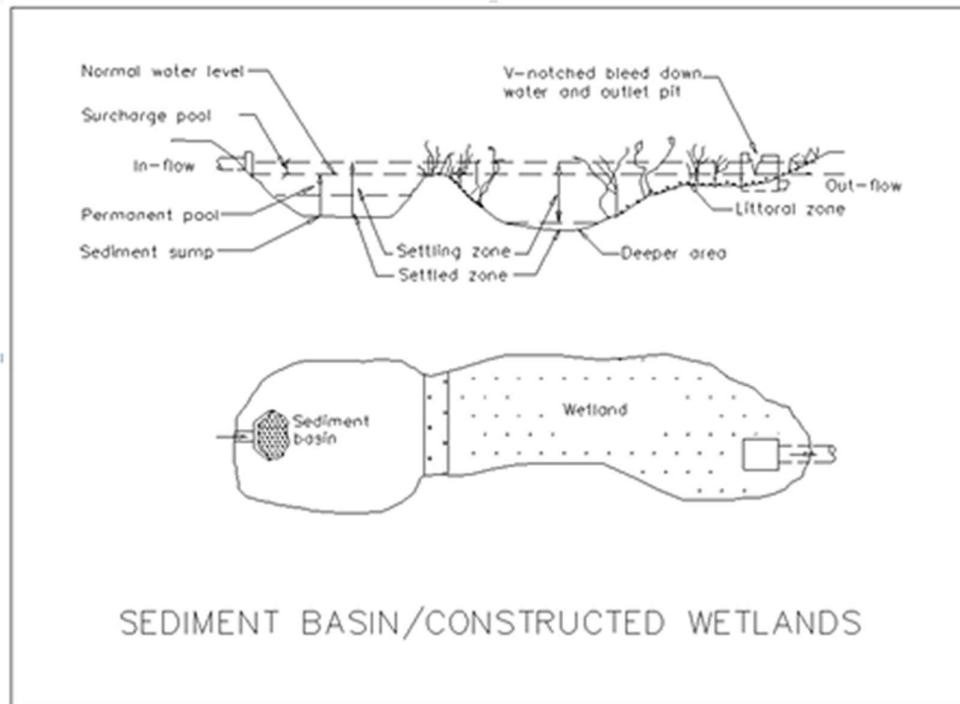


Figure 5: Sediment Trap / Constructed Wetland

11.15.3 Buffer Strips, Vegetated Swales and Bio-retention Systems

11.15.3.1 Buffer Strips

Urban catchments: Grassed areas that direct runoff from adjoining impervious areas to the stormwater discharge location.

Design: To EAARQ clause 10.3 and consider the following:

- Maximum slope: 5%.
- Maximum velocities: 0.4m/s.
- Usage of flow spreaders.
- Vegetation density.
- Distribution/spread of stormwater over the buffer strip.
- Prevention of rill formation through properly designed entry conditions and vegetation.

11.15.3.2 Vegetated Swales

Design: To EAARQ clause 10.4.

Location: At any point in the catchment and as follows:

- At the top of a catchment to serve minor drainage requirements.
- Downstream in the catchment with a parallel underground pipe network. Geometry: Trapezoidal or parabolic shapes.

Side slopes: No steeper than 1V:3H.

Longitudinal slope: 1 – 4%. If greater or less than 1 – 4%, conform to the following:

- Slopes greater than 4%: Design for check dams.
- Slopes less than 1%: Design for under drains.

Maximum swale width: 2.5m.

Maximum flow velocity: Conform to the following:

- For 63.2% AEP (1 year ARI) 0.5m/s.
- For 1% AEP: 1.0m/s.

Manning's 'n' value:

- For flow conditions where depth of flow is below the height of the vegetation: 0.15 to 0.3.
- For 1% AEP event: 0.03. 3.8.3 Bio retention systems Design: To EAARQ clause 10.5 with 2 or 3 subsurface layers as follows:
- Base or drainage layer: Coarse and poorly graded material, placed to encase the perforated drainage pipe.
- Transition layer: Prevents filtration media washing into the perforated pipes.
- Filtration layer: Media through which water is filtered, typically consisting of sandy loam.

11.15.4 Miscellaneous

11.15.4.1 Development on Flood Affected Land

The Developer is to comply with the Council requirements for development on flood prone land. Different criteria will apply for the type of development based on the hazard category and risk precinct classifications.

If the land has been identified as flood affected in the 10.7 (S149) certificate, the developers can do the following:

- Apply for a flood certificate (fee applies). or,
- Visit the Council website for flooding information applicable to the proposed development, please also refer to the Council DCP for more details.

For the catchments outside Council flood studies, the developers are advised to have their own flood assessment by employing a Professional Engineer having appropriate experience and competence in the relevant registered area of practice.

Council has no legal obligation to undertake a flood study for a private development.

Model type required for Floodplain analysis:

Council's floodplain modelling has been undertaken using "TUFLOW", software. Council will consider the use of other models as appropriate.

When a development changes the flooding situation where existing flood information is available, the developer must fund Council's nominated consultant, who will be managed by Council, to run the existing flood model under the proposed development conditions.

11.15.4.2 Easements

Requirement: Identify points of discharge of gutters or stormwater drainage lines or any concentration of stormwater onto adjoining properties. Permission to discharge stormwater

drainage onto or over adjoining properties and formalising any required easements is the responsibility of the developer.

Easement width:

- Minimum:
 - 3m for new developments benefitting Council,
 - 3m for inter-allotment drainage not benefitting Council (private drainage)
- Maximum:
 - To contain the full width of overland flow or open channel flow in the major system design event. If the 1% AEP flow is $1\text{m}^3/\text{s}$ or greater, mark it as a drainage reserve.
- Trunk drainage is defined as any structure with a flow $\geq 1\text{m}^3/\text{s}$ for the 1% AEP storm, or where an open channel, or any structure where another public facility such as a cycleway is parallel to the drainage structure and within the overflow path
- All trunk drainage is to be located within a Drainage Reserve dedicated to Council and cannot be within an easement through private properties.
- Council may consider variations to the above on merit.

No structures can be built on stormwater assets (pipes, pits, open channels etc.) on an easement or without.

Easements over private property:

- Do not surcharge major system flows across private property.
- Contain flows for 1% AEP event considering fences,
- Plan and consider how access will be gained to the easement for maintenance purposes. Consideration should be given to the method of works for undertaking maintenance and the impact on private property. For example, suitably designed and constructed driveways to cater for plant such as trucks used for maintenance.
- Easements over inter-allotment stormwater drainage pipes only shall be in favour of private properties.
- Trees, landscaping, fencing and other structures shall not be located across or within an easement.

11.15.5 Legal Point of Discharge and Right to Discharge Stormwater

Scour protection at culvert or pipe system outlets shall be specified.

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

The developer shall meet the cost of the easement(s).

Council will require proof that downstream easements from the subject property have been obtained for stormwater runoff. The easement shall be continuous from the subject property through to a watercourse with defined banks or to a Council drain or drainage reserve (only permitted where classification of the land pursuant to the Local Government Act 1993 permits this to occur).

Where the drainage is to discharge to an area under the control of another statutory authority e.g., DPIE, the design requirements of that Statutory Authority are also to be met.

Discharge to public reserves (Community Land) - piped stormwater drainage discharging to Community Land shall only occur where the Plan of Management for the land so allows and is to be taken to a natural watercourse and discharged in an approved outlet structure and in accordance with the requirements of DPIE, or alternatively be taken to the nearest trunk stormwater line.

11.15.5.1 Land Tenure of Drainage System

Trunk drainage is defined as any structure with a flow $\geq 1\text{m}^3/\text{s}$ for the 1% AEP storm.

All trunk drainage is to be located within a Drainage Reserve dedicated to Council and cannot be within an easement over private properties.

All other drainage that is not within a public road or community land shall be located within a drainage easement.

Easements over inter-allotment drains shall be in favour of the properties served.

If Council is benefitted shall be in favour of Hilltops Council and other properties where appropriate.

Consideration is to be given to accessibility and maintenance within older subdivisions.

Creation of residue land should be avoided.

11.15.5.2 Roofwater Disposal

Final means of disposal of stormwater to Council's stormwater system must be approved by Council. The following types of disposal will generally be acceptable:

- a) Disposal to an interallotment drainage system with connection to the junction provided
Where no junction or inter-allotment stormwater pit is provided, a new 45° sweep is to be laid in the interallotment drain for connection. Any other form of connection is prohibited.
The capacity of existing system must be ascertained before any connection.
- b) Disposal to Council's kerb and gutter by connection into the outlet provided – Where no outlet is provided in the kerb and gutter a saw cut of the kerb and gutter will be permitted and prefabricated galvanized steel stormwater adapter is to be placed within the kerb. A high strength concrete mix shall be used to reinstate the kerb, and this must match the profile of the kerb. Where more than one outlet is to be placed within a kerb a spacing of two (2) metres between the outlets shall occur.
- c) Disposal to Council's road table drain may occur provided the pipe is maintained a suitable distance from the road carriageway to ensure damage does not occur. The outlet of the pipe must be protected by the placement of solid protection, such as concrete around the outlet to prevent damage to the pipe. Other means of disposal to the table drain in areas without kerb and gutter may be accepted by Council. Details are to be submitted and approved.
- d) Disposal directly to Council's stormwater mains is permitted subject to certain conditions. Details are to be obtained from Council's Engineering staff. However, it depends on the capacity of existing stormwater system.
- e) On site stormwater disposal may be permitted on allotments with an area of less than 4000m² a hydraulic consultant's report may be requested by Council to verify that on site disposal can occur without damaging buildings, cause a nuisance to neighbouring

properties or create a problem through adding stormwater into the ground surface (A Geotechnical Engineer may also be required to verify this issue).

- f) The disposal trenches shall be located a minimum distance of 5 metres from any adjoining property boundary. In circumstances where there is a larger roof and hardstand area, or soil conditions make disposal unsuitable, other means of disposal will be required.

Stormwater/retention trenches must be located downstream of any septic tank effluent/sullage disposal area. Trenches, drains and pipes shall not traverse or penetrate any effluent disposal area. The typical size of trench for each downpipe is 3 metres long, 600mm wide and 600mm deep however this is dependent on soil conditions. Where concealed gutters, box gutters, high fascia gutters (without storm ports) and/or internal downpipes have been installed it is advisable that a surcharge grating mounted above the finished surface be installed adjacent to the base of the downpipe connection of the drain/pipe.

- g) Where adverse falls occur from the roof drainage system to the final disposal point, the proposed method of drainage and disposal is to be submitted to the Council for approval. In these instances, the provision of an easement with the fall of the land to Council's stormwater disposal system, is the most suitable solution. For on-site disposal options see above. A pump system for conveyance of stormwater will not be permitted.
- h) Disposal of stormwater into collection tanks will be permitted by Council provided the overflow is conveyed to a means of disposal specified above as appropriate. Where the water is to be used for domestic purposes, a first flush system should be installed and must be compliant with all BASIX conditions.
- i) Stormwater runoff from areas where water may become polluted will be subject to suitable pretreatment measures as specified by Council and other statutory authorities.

11.16 Documentation

11.16.1 General

11.16.1.1 Approvals

Requirement: Document the approval conditions advised by the appropriate authority which contribute to the basis of the design of the stormwater drainage.

Development assessment requirements:

Provide a Stormwater Management Plan including the following:

- Catchment plan showing upstream contributing catchments.
- Existing downstream drainage with capacity assessment.
- Proposed detention/retention.
- Concept Design with a background image with an appropriate hydrologic/hydraulic model.
- Proposed easements and drainage reserves.
- Flooding information (for flood liable land).
- Legal discharge point.

11.16.1.2 *Design Reports*

Requirement: Provide a design report including the following:

- Design criteria.
- Site investigation reports supporting the design.

Provide a design report incorporating the criteria, assumptions, reference documents, supporting information, catchment plans, computer studies, calculations and references supporting the design, Stormwater Management Plan report

11.16.1.3 *Design Certification*

Requirement: Provide a signed and dated design certificate.

11.16.1.4 *Final Certification of Completed Design Works*

Requirement: Provide a signed and dated design certificate.

11.17 Stormwater Design Drawings

11.17.1 General

Requirement: Provide drawings and/or computer output defining the works and assumed operating and maintenance procedures.

11.17.1.1 *Catchment Areas Plan*

Catchment Area Plans shall show:

- Contours.
- Direction of grading of kerb and gutter.
- General layout of the drainage system with pit locations, catchment limits.
- Any other information necessary for the design of the drainage system. Scales: 1:500, 1:4000 or 1:25000.

11.17.1.2 *Drainage System Layout*

Drainage system layout drawings: Provide drawings showing the following:

- Drainage pipeline location.
- Drainage pit location.
- Number and road centreline chainage.
- Size of opening.
- Drainage easements.
- Reserves and natural water courses.
- Location of buffer strips, vegetated swales and bioretention systems.
- Location and details of infiltration systems.
- Any other information necessary for the construction of the drainage system.
- If appropriate, combine with the road layout plan.

- Scale: 1:500.

11.17.1.3 Longitudinal Section

Drainage system longitudinal sections:

- Pipe size.
- Pipe class and type.
- Pipe support type to AS/NZS3725 or AS/NZS2032.
- Pipeline and road chainages.
- Pipeline grade.
- Hydraulic grade line.
- Existing and proposed public utilities intersecting the drainage line, including approximate levels of the utility.
- Any other information necessary for assessment of the drainage system.
- Horizontal scale: 1:500.
- Vertical scale: 1:50.

11.17.1.4 Open Channel Cross Sections

Provide drawings showing the following:

- The direction of the view of cross sections, normally downstream.
- Reduced levels to Australian Height Datum.
- Provide a data input file for the design flow rates.
- Scale: 1:100.

11.17.2 Other Documentation

Detailed drawings: Provide details including standard and non-standard pits and structures, pit benching, open channel designs and transitions to scales appropriate to the type and complexity of the detail being shown.

Submit hydrology and hydraulic summary sheets: A catchment map must accompany the Stormwater Management Plan with a report showing contributing catchments. Results of the model run. Computer models should be built on a background clearly visible. Copies of final computer data files, for both hydrological and hydraulic models shall be provided in formats previously agreed with Council.

Model type required for Design: Council uses “DRAINS” software for urban situations and “TUFLOW” software for urban hydraulic modelling and rural situations and will consider the use of other models as appropriate.

DRAINS is primarily intended for urban drainage network design and assessment, including hydrologic and hydraulic analysis of minor drainage systems. It shall be used in designing such items as:

- OSD tanks and Drainage design
- Hydraulic grade line checks

- Standard urban developments

Where complex floodplain behaviour, overland flow paths, flood impacts or two-dimensional hydraulic interactions are significant, TUFLOW or another Council-approved 2D hydraulic model shall be used. Examples of its use are:

- Flood Prone Land – assisting in determining a 2D model for Flood impact Assessment.
- Complex Overland Flow; modelling overland flood pathways especially when new buildings are proposed, determining floor levels etc.
- Basement entry modelling impacted by driveways/speed humps and alike.

Computer data files and output: Submit final hydrological and hydraulic computer data files.

Landscape plans and planting plans: Provide for buffer strips, vegetated swales and bio-retention systems.

11.18 Interallotment Stormwater Drainage

Interallotment drainage shall be provided for every allotment which does not drain directly to its street frontage and for high side properties fronting roads with either kerbing that is unable to satisfactorily accommodate kerb outlets or where the road has one-way crossfall. The interallotment drainage shall be deep enough to serve the entire allotment; property inlets shall be constructed at the low corner of each lot in accordance with Council's Engineering Guideline - Standard Drawings.

A maximum of 10 allotments shall be served by an interallotment drainage system. Council reserves the right to restrict the maximum number of allotments served based on catchment characteristics and potential for runoff concentration onto downstream properties.

Interallotment drainage in residential areas shall be designed to accept concentrated drainage from buildings and paved areas on each allotment for 5% AEP design flow rates unless otherwise advised by Council's Representative for other land use zones.

Stormwater discharge from adjoining existing lots onto proposed development sites shall be catered for by the Service Provider by the provision of an interallotment drainage system providing a point of connection for each existing adjoining lots. This will necessitate the construction of the drainage system and creation of easements in favour of the existing properties.

Interallotment drainage shall be placed centrally within easements with a minimum width of 1.5m. A smaller easement may be accepted by Council only in certain circumstances. The easements shall be created in favour of benefiting allotments. Ongoing maintenance of interallotment drainage remains the responsibility of the benefiting allotments.

Where future developed impervious areas cannot be determined, the assumed impervious surface areas in Table 16 shall be used.

Pipes shall have a minimum diameter of 225mm and designed to flow full at the design discharge without surcharging of pits. Consideration shall be given where connections are proposed to other systems designed under pressure.

Interallotment drainage systems shall be constructed from the following pipe types. Joint types shall be rubber rings:

- Fibre-reinforced concrete pipe - AS 4139:2003 Fibre reinforced concrete pipes and fittings.

- Reinforced concrete pipe - AS/NZS 4058:2007 Precast concrete pipes (pressure and non-pressure).
- uPVC pipe - AS/NZS 1254 PVC-U pipes and fittings for stormwater and surface water applications.

Pipes shall have a minimum cover of 300mm and a desirable minimum grade of 1%.

Where interallotment drainage and sewer mains are laid adjacent and parallel to each other they shall be aligned at 750mm between pipe centre lines unless pipelines are greater than 300mm diameter for which the minimum clearance between pipes shall be at least 450mm. The sewer shall be located closest to the dwelling being served and may need to be contained within a separate easement.

Where sewer mains are in close proximity to interallotment drainage lines they shall be shown on the interallotment drainage plan.

11.19 Interallotment Drainage

11.19.1 General

Inter-allotment Drainage shall be provided for every allotment where roof water and surface water cannot be discharged directly to the street drainage or a natural watercourse. Inter-allotment drainage shall be contained within an easement not less than 3.0m wide, and the easement shall be in favour of the benefiting allotments.

Inter-allotment drainage pits shall be located at the low corner of each lot, at all changes of direction and at distances no greater than 60m.

Pipe Capacity:

- Inter-allotment drainage shall be designed for 0.2EY events.

Pits are to be grated unless proven that upstream catchment will generate debris and cause blockage. Deviation from the grating specifically will require formal approval by Council. While designing, the upstream contributing catchment must be considered. The inter-allotment drainage system forms part of the overall drainage system that needs to be checked and approved. Development Type In lieu of more detailed analysis, the following Table 16 shows development type and the associated percentage of area of impervious surface assumed to be contributing runoff for any urban drainage area.

Table 16: Development Type and % of Lot Area Impervious

Development Type	% of Lot Area Impervious
Low Density Residential (R2)	40
Medium Density Residential (R3)	70
Industrial	85
Commercial	95

All pits shall be cast in-situ and/or precast concrete to the relevant Australian Standards, as required by specific pit dimensions and constructability requirements. Council reserves the right to approve the type and quality of any proposed precast products prior to installation

and shall require all quality documentation to be submitted in support of the proposed products prior to approval.

Connection of roof water drainage for single residential dwellings shall be provided by connecting a minimum 100mm diameter stub into the side of the pit.

The use of pits other than precast or cast in-situ are prohibited, i.e. pits shall not be constructed of plastic or fibreglass.

All pit grates shall be hinged and lockable. Grates not complying shall be removed and replaced with hinged and lockable grates, i.e. drop-in grates are not acceptable.

All pit grates shall be locked at all times and re-locked after final inspection and acceptance of pits by Council's Representative. Minimum pit sizes; inlet and grate types shall be in accordance with Table 17 Pits in Driveways (Right of Carriageway, Right of Way and Access Handle) and Table 18 Interallotment Drainage Pits (for Pits not Situated in Driveways).

Pits located in driveways (Right of Carriageway, Right of Way and Access Handle) shall be cast in-situ. Where an inlet is located in an open drain, the inlet shall be a raised grated inlet. Pits in excess of 3.5m in depth require a design by a Structural Engineer with details submitted to Council for approval. Certification shall be provided to Council following construction of the pits.

The minimum length of kerb inlet shall be 900mm. Where the flow rate and/or grade warrant, an extended kerb inlet shall be used. In circumstances where physical constraints such as width do not permit a kerb inlet, an adequate number of grated inlet pits shall be installed.

Table 17: Pits in Driveways (Right of Carriageway, Right of Way and Access Handle)

Depth to Invert D (mm)	Internal Pit Size (mm)	Inlet Type	Grate Size and Type
D < 1800	900 x 670	Kerb Inlet	900 x 450 Heavy-duty hinged grate
D ≥ 1800	900 x 900	Kerb Inlet	900 x 450 Heavy-duty hinged grate

Table 18: Interallotment Drainage Pits (for Pits not Situated in Driveways)

Depth to Invert D (mm)	Internal Pit Size (mm)	Inlet Type	Grate Size and Type
D < 450	450 x 450	Grated Surface Inlet	450 x 450 hinged grate
450 ≤ D < 900	600 x 600	Grated Surface Inlet	600 x 600 hinged grate
900 ≤ D < 1200	900 x 600	Grated Surface Inlet	900 x 600 hinged grate
1200 ≤ D < 1800	900 x 600	Grated Surface Inlet	900 x 600 hinged grate

D ≥ 1800	900 x 900	Grated Surface Inlet	900 x 900 hinged grate
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11.20 Stormwater Drainage Easements and Reserves

11.20.1 General Requirements - Easements

A drainage easement shall be wide enough to contain the pipeline and provide working space on each side of the pipeline for future maintenance activities. Stormwater pipelines shall be laid centrally within the easement unless approved by Council's Representative.

Only pipelines up to and including 675mm diameter may be located in easements within private properties. Larger diameter pipelines shall be located outside private properties in open space or in separate drainage reserves.

In some developments, direct maintenance access to a stormwater system within a lot may be difficult or prevented entirely. In such cases, easements and interallotment pipelines shall not terminate at a dead end but shall be extended to a point where access may be gained from a road reserve or other public area with direct access. A junction pit shall be located on both ends of the pipeline to facilitate access. Easements shall be provided in private property over public and interallotment drainage systems and overland flow paths. The minimum width of easement shall be as Table 19.

Table 19: Minimum Easement Widths

Pipe Diameter (mm)	Minimum Easement Width (m)
Interallotment drainage (≤ 300 maximum)	3.0
375 to 675	3.0
750 to 900	3.0
1050 to 1200	3.5
1350 to 1500	4.0
1650 to 1800	4.5

For multi-cell pipes/culverts a minimum clearance of 500mm from the outer edge of the pipes/culverts will be required for the easement width, with the easement width increasing in 500mm intervals.

Where the depth of stormwater pipe is greater than 3m the easement width shall be approved by Council's Representative.

Generally, no buildings or overhanging structures are permitted over drainage easements for Council's stormwater drainage system. Overland flow paths within drainage easements shall require property restrictions to ensure the shape, alignment and capacity of the overland flow path remains unaltered.

11.20.2 General Requirements Drainage Reserves

Consideration shall be given to the multi-purpose use of drainage reserves such as open space or pedestrian corridors.

Minimum widths of drainage reserves or pathways and public reserves containing stormwater pipes shall be in accordance with Table 20 unless otherwise directed by Council's Representative.

Table 20: Minimum Drainage Reserve Widths

Drain Width (mm)	Reserve Width (m)
0 – 3.0m deep	
Less than 750	3.0
750 to 900	3.5
1050 to 1200	As Directed
3.0 – 6.0m deep	
Less than 525	3.5
525 to 675	4.0
750 to 900	4.5
1050 to 1200	As Directed

Note: Where other services are located within the same reserve, the required reserve width shall be increased to provide adequate clearance between services.

11.21 Hydraulic Design and Pipeline Design

11.21.1 Hydraulic Grade Line (HGL)

Hydraulic calculations shall be undertaken by a qualified person experienced in hydrological and hydraulic design, and be based on ARR 2019, in particular:

- Chapter 4 (Numerical Models) within Book 6 (Flood Hydraulics).
- Chapter 5 (Stormwater Conveyance) within Book 9 (Runoff in Urban Areas).
- Chapter 6 (Modelling Approaches) within Book 9 (Runoff in Urban Areas).

The hydraulic design shall be calculated assuming full pipe flow and shall be described in the Design Drawings and supporting documentation by:

- DRAINS software (minimum requirement) or similar software product must be used for hydraulic calculations for submission to Council.
- Hydraulic grade line on pipe profiles with accompanying levels at inlets, pits and outlets.

- Calculations of adopted water level controls, tail water levels and flood levels applying to the site.
- Appropriate allowances for climate change shall form part of the design flow rate.
- Tabulation of calculations in association with hydrological calculations.
- Inclusion of listings of all software program input and output.

Downstream hydraulic grade line level requirements for design shall be determined from the following criteria:

- If the outlet is into a pond/dam, then the adopted HGL at the downstream outlet shall be equal to the adopted “let out” level adopted at that time for that particular pond.
- If the outlet is at a location where Council has flood mapping available, then the 20% AEP (5-year ARI) flood level at that location shall be adopted. This will apply for creeks and areas of overland flooding.

11.21.2 Design Criteria

Pipes shall be designed by a hydraulic grade line (HGL) method assuming full pipe flow using appropriate pipe friction and drainage structure head loss coefficients.

The hydraulic grade line level in drainage pits shall be limited to 150mm below the gutter invert, 150mm below surface inlet level and 150mm below the underside of the lid for junction pits unless otherwise approved by Council’s Representative.

11.21.3 Grades

The longitudinal grade of a pipeline between drainage structures shall be calculated from midpoint to midpoint of such structures. A minimum of 50mm fall shall be allowed in all drainage structures (i.e. pits) which shall be shown by the level difference of the inflowing pipe(s) and the out flowing pipes at the midpoint. In areas where this cannot be achieved approval shall be obtained from Council’s Representative.

11.21.4 Minimum Pipeline Grades and Velocity

Stormwater pipelines shall be designed and constructed to be self-cleansing, e.g. free from accumulation of silt. The desirable minimum grade for pipelines with a diameter less than or equal to 600mm is 2% and with a diameter greater than 600mm is 1.0%. The minimum pipe full flow velocity shall be 0.6m/s.

A minimum grade of 0.5% may be acceptable where steeper grades are not practicable. Such instances require the approval of Council’s Representative prior to finalising designs.

11.21.5 Maximum Grades and Velocity

Pipeline grades shall be chosen to limit the pipe full flow velocity to a desirable maximum value of 3.0m/s. The manufacturer’s guidelines shall not be exceeded. Where the manufacturer’s guidelines allow greater than 3.5m/s, approval from Council’s Representative is required. Care shall be taken to consider the requirements of high energy flows on pit design, pipeline joint pressure capabilities and the potential need for pipe outlet scour protection measures.

11.21.6 Scour Stops, Trench Stops, Bulkheads

Pipelines laid on steep slopes and in relatively impervious materials such as rock shall be protected from failure due to wash-out of bedding and backfill by the use of scour stops,

trench stops or bulkheads. Measures shall be considered by the Designer and detailed on the drawings. Details will be required for all pipeline grades that are greater (>) than 20%. Refer to Council's Engineering Guideline - Standard Drawings.

11.21.7 Vertical Angles

Stormwater pipelines shall be constructed so that the bore of the pipe has no point where debris can lodge and cause reduction in capacity. The use of vertical angles shall not be permitted.

11.21.8 Allowable Pipe Diameters

11.21.8.1 Minimum Diameters

Council Drainage Systems

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

Interallotment Drainage Systems

- The minimum diameter for stormwater pipelines is 225mm other than for individual residential stubs and connections which may be 150 mm diameter where capacity is demonstrated to be sufficient and subject to Council approval.

Private Drainage Systems

- The minimum diameter for stormwater pipelines shall be in accordance with AS/NZS 3500.3 Plumbing and drainage - Stormwater drainage.

11.21.9 Structural Design of Pipelines and Box Culverts

11.21.9.1 Minimum Design Service Life

Pipelines and culverts shall be designed and installed for a minimum effective service life of 100 years. Where conduits are continuously or frequently submerged or installed in aggressive soils/groundwater (e.g. saline, sulphate-rich, acidic, or with high electrical conductivity), specify materials and durability measures to achieve the design life in accordance with the relevant exposure/durability classifications (e.g. AS 3600 for concrete durability, AS/NZS 4058 for precast concrete pipes, AS 1597.1/2 for box culverts, and the applicable product standards for PVC/PE/steel). Suitable measures may include increased cover, higher concrete strength/density, sulphate-resistant binders, protective linings/coatings, sacrificial thickness, or equivalent proven systems.

11.21.9.2 Minimum Depth

The minimum cover over stormwater pipelines that will become Council's Asset shall be 700mm from top of pipe to finished surface level or gutter invert level for road drainage.

Minimum cover requirement for interallotment drainage is 300 mm.

Pipe depth shall satisfy the cover requirement for the nominated class of pipe, bedding type and construction loadings determined from AS/NZS 3725 Design for installation of buried concrete pipes.

Box culvert depths shall satisfy the cover requirement for box culvert roadway load class, bedding type and construction loadings determined from AS 1597.1 and AS 1597.2 Precast reinforced concrete box culverts.

11.21.9.3 Maximum Depth

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

In special cases (e.g. for a short length of pipeline through a ridge), approval must be obtained from the Council's Representative to exceed this limit.

11.21.10 Reinforced Concrete Pipe and Box Culvert Class

Pipe class shall be selected to provide adequate strength to meet overburden and traffic loads determined from AS/NZS 3725 Design for installation of buried concrete pipes. Pipe class shall be calculated assuming a HS support condition for pipes under road pavements and for pipes not under a road pavement.

In calculating pipe class consideration shall be given to design loading and assumed construction loads. Where load limits are intended to apply, the location and load limitation shall be clearly shown on the drawings along with appropriate signs to be installed identifying the load limit.

Box culvert roadway load class shall be selected to provide adequate strength to meet overburden and road traffic loads determined from AS 1597.1 and AS 1597.2 Precast reinforced concrete box culverts.

When designing box culverts, requirements for exposure classification in accordance with AS 3600 Concrete structures shall be provided on the Design Drawings.

Drainage pipes installed within road reserves where TfNSW is the roads authority shall be RCP Class 4.

11.21.11 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. Details of required flexible joints and their locations shall be detailed on the drawings.

Private connections into Council's stormwater drainage system are to be made at a drainage pit. Direct connections into Council's drainage pipelines are not favoured and are generally not permitted. However, Council may consider a direct connection into a drainage pipeline with a 150mm diameter or smaller PVC pipe connection using a proprietary connection fitting system, which shall be approved by Council's Representative.

11.21.12 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, e.g. parallel to a kerb line.

When curved pipelines are used the following shall apply:

- Curved pipelines shall have a constant radius.
- Curved pipelines shall have a single horizontal plane only (no vertical curves or reverse curves).

- The maximum deflection angle shall be as recommended by the pipe manufacturer for a particular pipe.
- Splayed pipes may be used to construct a curved pipeline provided that the curve is totally formed by the splays. Splayed pipes shall be factory formed.

Design Drawings shall show the following curve information:

- Centre line radius.
- Pipe type (normal or splayed).
- Effective length of individual pipes (if other than standard length).
- Type of jointing.
- The Designer shall provide documentation to show that the above details are within the pipe manufacturer's specifications.

11.21.13 Dead End Pipelines

Dead end pipelines are not permitted. All Council or proposed Council stormwater pipes shall terminate at pits or inlet/outlet structures. Short lengths of pipe may be detailed at end pits to facilitate future connection.

11.21.14 Interallotment Drainage Connections

Connection of interallotment pipe systems to Council's drainage systems shall be made at a Council stormwater pit or by way of an approved discharge structure into an open channel or watercourse. Where a new junction pit is required to accommodate interallotment drainage connection approval is required from Council's Representative.

11.22 Road Culvert Design

A culvert is a stormwater drainage structure designed to satisfy the hydraulic requirement associated with conveying water under roads and to have structural strength to carry construction or highway traffic loads and loads associated with the road formation.

11.22.1 General

Box and pipe culverts shall be designed in accordance Austroads - Guide to Road Design - Drainage Sets - Part 5, Part 5A and Part 5B. Design of pipe or box culverts shall consider and make provisions acceptable to Council for maintenance of the culvert.

11.22.2 Major System Requirements

Box or pipe culverts may be used as part of the major stormwater system in engineered waterways for road crossings.

Culvert crossings shall be designed for a 1% AEP flow and be in accordance with the relevant town area Flood Study. Appropriate allowances for climate change shall form part of the design flow rate.

An upstream freeboard of at least 600mm, for a 1% AEP flow, shall be provided, unless an alternative is approved by Council's Representative.

Culvert crossings shall be designed without afflux unless otherwise agreed with Council's Representative.

Major structures within rural area shall be designed to accommodate the 1% AEP flood events. A maximum 200mm depth of flow combined with a maximum velocity of 1m/s is permitted over the top of the structure (Refer to 11.24.1 General Requirements – Flow Paths).

A minimum clearance of 500mm between the 1% AEP flood level and the underside of any bridge superstructure is required to allow for passage of debris without blockage.

Certified structural design shall be required on bridges and other major culvert structures and may be required on some specialised structures. The design shall be carried out in accordance with AS(/NZS) 5100 Bridge Design Series and Austroads Guide to Bridge Technology.

Culverts (either pipe or box section) shall be designed with due regard being given to inlet and exit losses, inlet and outlet control and scour protection.

11.23 Stormwater Pits – Inlet and Junction

11.23.1 General

Stormwater pits shall be designed to efficiently conduct storm flows from the design surface to the underground pipe system.

When designing pit locations, consideration shall be given to stormwater overland flow widths, hydraulic efficiency, vehicle, bicycle and pedestrian safety, debris collection potential and maintenance. A risk assessment approach shall be applied when designing stormwater pit and pipe inlets that may be accessed by the public. Inlet pipe diameters greater than 300mm shall be covered with a grate, grille and/or safety screen structure with a maximum gap of 150mm to prevent entry by a child.

For hydraulic losses relating to pits generally, 1.5 will be a conservative value for k_u in flow through pits. For pits at the top of a line, however, a value of 4 or 5 is appropriate.

Pressure change coefficients can be obtained from sources such as the Missouri and Hare charts. However, a difficulty is that ratios of flows or pit water levels are required in many of these, so that they cannot be accurately determined in advance. This is why a number of iterations in the design model is required before these ratios stabilise or change relatively minimal. It is expected that the hydraulic design report will articulate starting loss/s values, number of iterations and the adopted loss value/s after these iterations.

It's generally regarded that a starting k_u loss factor for a 90° change in direction pit is about 2.7. For pits on straights a starting k_u factor might be 0.3.

As a starting guide, Refer to the latest edition of Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia and the Queensland Urban Drainage Manual for further guidance. The designer should be nominating what k_u values are used and stated in the standard design report or calculation sheet for respective design.

This factor determination is critical for change in direction pits especially for 90° bends.

Another factor that is also critical is nominating Tail Water level. This has a large bearing if not dictates HGL at the most upstream point of the design.

This most important iteration process modelling hydraulic losses, the Queensland Urban Design Manual (QUDM) methods and charts suggest:

1. Run and analyse major or minor storms.
2. Run and revise pit loss coefficients using QUDM method.

3. Open Excel and paste to spreadsheet.
4. Repeat.
5. Run and analyse major or minor storms.
6. Run and revise pit loss coefficients using QUDM method.
7. Paste to spreadsheet, check convergence and decide whether to repeat.

Note: All the runs will be done without pit blockages.

11.23.2 Council Standard Pit Types

Pits shall conform to Council's current Engineering Guideline - Standard Drawings. Where a proposed pit does not comply with Council's Standard Drawings, the pit shall be detailed on the Design Drawings and approved by Council's Representative.

Inlet capacities of kerb inlet pit shall be documented within the design report.

General requirements are:

- Pits shall be provided in drainage lines at all changes in grade, level, and direction, and at all pipe junctions and shall be spaced at no more than 85m apart.
- Drainage pits are to conform with Council's standard drawings, or TfNSW standards for Classified Roads. Non-standard structures shall be constructed as detailed in the design drawings. Such designs shall comply with AS3600, AS4100, AS1657 and any other relevant standard.
- Where possible pits used for storm water drainage shall be fitted with circular lids.
- Junction pits shall be fitted with reinforced lids and approved lifting eyes.
- Precast pits, incorporating in situ bases, may be used with prior approval of Council's Representative.
- Every endeavour shall be made to maintain flow velocities through pits. Excessive drops will not be permitted.
- Pipe grading across pits should be designed on the following basis:
 - No change in direction or diameter - minimum 50mm.
 - Direction changes but no change in diameter - minimum 70mm.
 - Changes in pipe diameter should be graded from obvert to obvert.
- At pit connections, a 3m length of approved subsoil drainage pipe enclosed in a geofabric sock shall be placed alongside the incoming main pipe so as to enter the pit at the same invert level and adequately drain the main trench, in accordance with Council's standard drawings.
- Where the pit depth exceeds 600mm allowance for access into the pit is to be made via step-irons in accordance with the relevant Australian Standard.
- Pits shall be constructed with vertical walls.

11.23.3 Design Kerb Inlet Sizes

Kerb inlet lengths (lintels) shall be a minimum of 1.2m and maximum of 3m. Kerb inlet lengths of 900mm may be considered by Council's Representative in justifiable circumstances. Kerb inlet lengths refer to clear opening.

All kerb inlets are to have an inlet grate incorporated.

All grates within road reserves and pathways shall be 'bicycle friendly'.

All grate types shall have a load rating suitable for the location of the grate and adjacent areas. Heavy-duty grates shall be a minimum requirement in all locations. However, extra heavy-duty grates shall be used where frequent heavy vehicle loading will be encountered. The load rating of the grate shall be specified on the Design Drawings. Lintels and grates in road reserves shall be specified in the design and installed with a minimum Load Class D rating in accordance with AS 3996 Access covers and grates.

11.23.4 Location

Inlet pits shall be located to prevent ponding and to limit flow widths and depths to acceptable levels in accordance with this Design Guideline. Preference shall be given to the location of drainage pits at the upstream side of lots, upstream side of pedestrian crossing points and kerb returns.

Pits shall be provided as follows:

- To enable access for maintenance.
- At changes in pipeline direction, grade, size, level or class of pipe (if required due to dimensional difference).
- At junctions of pipelines.
- At low points in road gutters, i.e. sag pits.
- Within overland flow paths Inlet pits shall be located so as to restrict the maximum gutter flow width to 2.5m.
- Maximum spacing between any two consecutive pits is 85m.
- Pit bypass flows should be limited to 15% of the gutter flow at that location.
- At intersections, kerb inlet pits shall be constructed adjacent to the upstream kerb return tangent point where flows exceed 20L/s gutter flow width is more than 1m.
- The minimum clearance from the top of the manhole to the design pit water level should be 150mm.
- The product of flow velocity and depth of flow in the kerb and gutter should not exceed 0.4 m²/s.
- Kerb inlet pits should be located clear of horizontal curves, pedestrian desire lines, and vehicle driveways.
- Inlet conditions shall be designed so that the potential for blockage by silt and debris is minimised. This may require special treatment of the inlet sump under some conditions.

Pits within the road pavement/carriageway shall be avoided unless otherwise approved by Council's Representative. Future maintenance requirements shall be considered as part of this approval.

Kerb inlet pits for all roadways shall be located such that gutter flow widths do not exceed the surface flow limits specified in Section 11.13.2 Surface Flow Criteria.

11.23.5 Maximum Pit Spacing

The maximum recommended spacing of pits where flow widths are not critical is 75m. However, closer pit spacing (say 50m maximum) is desirable for pipe grade control and future pipe maintenance requirements.

11.23.6 Junction Pits

Junction pits may be used where there is no requirement at the pit location to collect surface water. Refer to Council's Engineering Guideline - Construction Specification Section 6.9.6 Access Opening Covers for Junction Pits and Drainage Structures.

11.23.7 Provision for Blockage

The percentage of theoretical capacity allowed in relation to type of pit is given in the Table 21 (ARR 2019 Book 6 Chapter 6).

Table 21: Provision for Blockage

Type of Structure		Blockage Condition	
		Design Blockage	Severe Blockage
Sag Kerb Inlets	Kerb inlet Only	20%	100% (all cases)
	Grated Inlet Only	50%	
	Combined Inlets	Capacity of kerb opening with 100% blockage of grate	
On Grade Kerb Inlets	Kerb inlet Only	20%	100% (all cases)
	Grated Inlet Only (longitudinal bars)	40%	
	Grated Inlet Only (transverse bars)	50%	
	Combined Inlets	10% blockage of combined inlet capacity on continuous grade	

11.24 Flow Path and Open Channel Design

11.24.1 General Requirements – Flow Paths

Flow paths shall be designed in accordance with ARR 2019, and in particular:

- Chapter 5 (Stormwater Conveyance) within Book 9 (Runoff in Urban Areas).
- Chapter 7 (Safety Design Criteria) within Book 6 (Flood Hydraulics).

Flow path designs shall address the following items as a minimum:

- Velocity depth criteria for safety of vehicles and pedestrians.
- Containment of flows within the designated flow path area.
- Transition of flows between different flow path formations to ensure no inundation of private property.
- Surface treatment of the flow path to ensure ongoing flow path capacity with minimal maintenance.

11.25 General Requirements – Open Channels

Open channels that form part of the trunk drainage system to cater for major event (1% AEP) flows shall be designed to have smooth transitions with adequate access provisions for maintenance and cleaning. Design of open channels shall be in accordance with:

- Chapter 2 (Open Channel Hydraulics) within ARR 2019 Book 6 (Flood Hydraulics).
- Chapter 5 (Stormwater Conveyance) within ARR 2019 Book 9 (Runoff in Urban Areas).
- Chapter 7 (Safety Design Criteria) within ARR 2019 Book 6 (Flood Hydraulics).
- Austroads - Guide to Road Design - Drainage Set unless otherwise specified.

Open channel systems shall be designed to contain the major flow with the required freeboard.

Designs shall be carried out to adequately accommodate the following:

- Hydraulic jumps/supercritical flows.
- Transitions and constrictions of the channel - backwater effect.
- Superelevated flows (around bends).
- Freeboard/provisions for debris under structures, etc.
- Prevention of persons falling or being swept into the open channel.
- Permit easy escape by persons from flood waters.
- Catch rails, side bays or other escape devices as required.
- Minimise velocities or average velocity depth products recognised to safe limits.

Surface treatments of open channels shall be designed to retain channel capacity with minimal maintenance. Due allowance in design capacity shall be made to cater for proposed fully established vegetation treatments. Proposed surface treatments shall be discussed with Council's Representative at the preliminary design stage.

The open channel design must be in accordance with the current, NSW Department of Primary Industries, NSW Department of Climate Change, Energy, the Environment and Water and NSW Local Land Services requirements.

Suitable exclusion fencing acceptable to Council's Representative shall be provided along open channel sections that cannot satisfy safety criteria. Fencing shall make adequate allowance for other safety treatments, maintenance and emergency access.

Generally, open channels will only be permitted where they form part of the trunk drainage system and shall be designed to have smooth transitions with adequate access provisions

for maintenance and cleaning. Open channels will be designed to contain the major system flow less any flow that is contained in the minor system, with an appropriate allowance for blockage of the minor system. Typical Manning's "n" Values for Open Channels and Pipes is shown below in Table 22.

Table 22: Mannings Typical "n" Values Open Channels and Pipes

Material/Location	Manning's "n" Value
Concrete/Cement Fibre	0.014
uPVC, HDPE	0.013
Concrete box (fair-face)	0.013
Concrete (trowel finish)	0.015
Sprayed concrete ("gunite")	0.016
Bricks/pavers	0.016
Pitchers/dressed stone on mortar	0.017
Rubble masonry/rock lining/riprap	0.035 (will vary due to lining nominal size)
Corrugated Steel	0.033
Earth (with weeds, gravel)	0.035
Earth (clear)	0.025
Rock cut	0.040
Short grass	0.035
Long grass	0.050

Calculations supporting the design of all open channels shall be provided as part of the approval process for Design Drawings.

11.25.1 Location

Flow paths and open channels shall be located wholly outside private property unless specifically approved by Council's Representative.

Open channels shall generally be located along the alignment of existing watercourses and drainage depressions. Diversion of open channels away from natural drainage paths shall not be permitted.

11.25.2 Freeboard

The minimum freeboard above the “gap flow” for flow paths shall be as shown in Table 23 below. Figures are based on the 1% flood level. Where Table 23 does not address a particular situation, freeboard requirements shall be discussed with Council’s Representative.

Table 23: Minimum Freeboard Flow Paths

Flow Path Type	Minimum Freeboard# (mm)
Where adjacent to habitable floor levels	500
Swales and pedestrian pathways adjacent to property boundaries	300
Open channels to the top of channel formation	300

The minimum freeboard above the 1% AEP design flow level for open channels shall be 300mm to the top of the channel formation.

11.25.3 Natural Channels

Should include adequate rock protection for the low flows and minimal disturbance to the existing stream regime. The rock sizes to be determined on the basis of velocity for 1% AEP storms (refer QUDM 2013).

11.25.4 Grades

11.25.4.1 Minimum Grades

Open Channels and flow paths shall be constructed with sufficient longitudinal grade to ensure that unintentional ponding and/or the accumulation of sediment does not occur, particularly in locations where sediment removal would be difficult.

Flow paths shall generally have a minimum longitudinal grade of 0.5%.

11.25.4.2 Maximum Grades

Open Channels and flow paths shall be designed with longitudinal grades that minimise:

- Hydraulic jumps.
- Dangerous conditions for the public.
- Potential erosion.

Longitudinal grades shall be chosen such that the 1% AEP flow or “gap flow” will not exceed the average velocity limits shown in Table 24.

Table 24: Maximum Average Flow Velocities

Location	Average Flow Velocity (m/s)
Open channels	2

Swales and flow paths	2
Open channel low flow inverts lined	4

11.25.4.3 Drop Structures

Drop structures must be provided to reduce waterway longitudinal grades such that 1% AEP average flow velocities meet the requirements of Table 24 Maximum Average Flow Velocities above.

Drop structures shall be in accordance with the current NSW Department of Primary Industries, NSW Department of Climate Change, Energy, the Environment and Water and NSW Local Land Services requirements. Scour protection shall be provided at the upstream edge and downstream toe of the structure.

11.25.5 Advisory Signs

Floodway advisory signs shall be provided adjacent to open channels, natural waterways and flow paths where pedestrian safe velocity depth ratios cannot be achieved, refer to Section 11.24.1 General Requirements – Flow Paths. The location of signs shall be shown on the Design Drawings.

The signs shall be located at points of anticipated pedestrian traffic and shall be discussed with Council's Representative prior to incorporation into any design.

11.25.6 Batter Slope Requirements

Batter side slopes on open channels and flow paths shall generally not exceed six horizontal to one vertical (6:1) for reasons of public safety and maintenance. Steeper side slopes up to a maximum of four horizontal to one vertical (4:1) may be allowed where adequate provision for public safety have been incorporated into the design. The use of steeper batter slopes shall be discussed with Council's Representative prior to incorporation into any design. In any case the design of the basin embankment shall be verified by a suitably qualified geotechnical /civil engineer.

11.25.7 Low Flow Provision

Low flow provisions in open channels (man-made or altered channels) will require low flows to be contained within an approved treatment generally at the invert of the main channel.

The low flow system shall be designed to convey as a minimum a 1 in 3-month return interval flow. Adequate scour protection shall be provided adjacent to and within the above ground low flow system and any other areas as required.

The low flow system may also incorporate water quality treatment measures. Subsurface drainage may be required for grass-lined low flow channels to prevent waterlogging of the channel.

11.25.8 Erosion and Scour Protection

The design average flow velocity limits specified have been selected to prevent erosion and scour of surfaces under normal flow conditions. However, waterways may be subject to intense local erosion or scour at obstructions (e.g. bridge piers and pipe headwalls), sudden

changes in waterway cross sections, drops, regions of changes in waterway bed materials and other similar conditions.

Locations where specific erosion and scour prevention measures shall be considered include:

- Transitions - any changes in cross section or changes in the channel or flow path surface material. Particular attention must be paid to the region immediately alongside low flow inverts.
- Bends - the outside bank on bends subject to higher flow velocities.
- Pipeline outlets - flows from pipelines will normally be of relatively high localised velocity.
- Tributaries - other open channels entering the main channel/natural system may cause turbulence and erosion of the channel invert and banks.
- Energy dissipater structures - changes in the flow regime will usually occur immediately upstream and downstream of drop structures and energy dissipation basins.
- Culverts - exit velocities from culvert crossings will normally be supercritical.
- Bridges and underpasses - flow velocities around piers and abutments may be higher than the waterway limit.

Permanent erosion and scour protection must be provided to suit the location soil characteristics. Measures shall be detailed on the Design Drawings.

Advice from a Geotechnical/Civil Engineer may be required to identify soil characteristics.

All measures based on the identified soil characteristics shall be detailed on the Design Drawings.

11.25.9 Special Provisions

11.25.9.1 Major Traffic Routes

Collector routes shall be kept free of surface runoff in the 2% AEP flood event. Bridges and other major drainage structures shall be designed to pass the 1% AEP flood with freeboard of 500mm. Afflux and hydraulic gradients shall be determined in all cases. Note that bridges shall be designed in accordance with the Austroads publication and relevant Australian Standards.

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

11.25.9.2 Cul-de-Sacs

Where the fall is towards the turning head of a Cul-de-sac, the cul-de-sac shall have a floodway reservation or formed pathway in accordance with the Hilltops Council Standard Drawings at the sag point to ensure that major flows can be conveyed to a drainage reserve or overland flow path without flooding private properties.

11.26 Detention Basins

11.26.1 General

Detention basins may be provided as an integral part of the major drainage systems to either:

- Provide a more economic system by reducing downstream flow rates and waterway reserve widths; or
- Meet a specific planning or floodplain risk management plan requirement that downstream flow rates do not exceed pre-development values for both the major and minor system design AEP.

It must be recognised that the provision of a detention basin is only one method in several techniques available to manage stormwater runoff and therefore must be tested against other drainage strategies to arrive at the optimum solution to meet either of the above objectives.

The provision of detention basins in the drainage system must be planned and designed as part of an overall catchment drainage strategy.

For each AEP a range of storm events shall be run to determine the peak flood level, critical Storm and discharge from the retarding basin. At least 12 storms must be run up to 6-9 hours or longer durations depending on the catchment size.

Standard reservoir routing methods shall be used in detention basin modelling showing the inflow and outflow hydrographs. The high-level outlet to any retarding basin shall have capacity to allow the passage of a minimum of the 1% AEP flood event.

Additional spillway capacity may be required due to the hazard category of the structure. The hazard category should be determined by reference to ANCOLD (1986).

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

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

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

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

Public Safety Issues are tabled in Table 25.

Table 25: Public Safety Issues

Design Attribute	Requirement
Basin side slopes	Basin side slopes 1:6, steeper slopes may be accepted under exceptional cases with safety provisions.
Water depth at 20% AEP	Maximum 1.2m, greater depth may be accepted with safety provisions (refuge mounds etc.,)
Depth indicators if depth>0.3m	Shall be provided
Spillway	Signage required indicating hazard
Tree Planting	Not allowed on basin walls

Design Attribute	Requirement
Spillway Location	Not upstream of existing properties
Referral to dam safety committee	Decided on a case-by-case basis – capacity dependant
Fencing	Basin Depth $\geq 1\text{m}$
Maintenance Vehicle Access	Shall be provided

The Geotechnical Engineer designing the basin shall satisfy the requirements of the NSW Dams Safety Act 2015. Submission of design plans and risk assessment may be required.

Embankments shall be designed and constructed such that they will not breach under any operating conditions for all flows up to and including 1% AEP. Generally, the maximum inundation period during the critical duration 1% AEP design storm shall be 72 hours to prevent long term damage to surfaces. However, this will depend on any secondary usage of the basin.

Detention basins shall not cause floodwaters up to and including the 1% AEP event to inundate upstream roads or land.

11.26.2 Analysis

The Designer shall model the performance of the basin using a range of design storms and long-term records of rainfall to determine the maximum storage requirements and the size of outlets for the basin.

A hydrograph estimation technique shall be used to estimate appropriate inflow hydrographs to the basin. Inflow hydrographs shall be routed through the basin using full reservoir routing calculations to determine the basin characteristics and resultant outflow hydrographs.

Modelling of flood routing shall demonstrate that the basin does not have an adverse impact on the total catchment mainstream flooding, and be based on ARR 2019 and in particular:

- Chapter 5 (Flood Routing Principles) within Book 5 (Flood Hydrograph Estimation).
- Chapter 4 (Stormwater Volume Management) within Book 9 (Runoff in Urban Areas).

11.26.3 Outlet Design

11.26.3.1 Bypass Flows

Provision shall be made in a detention basin design to bypass low flows through or around the basin. This is necessary to ensure that the basin floor, particularly if it is grassed, is not inundated by small storms or continually wetted by dry weather base flow. The minimum amount of bypass shall be the 12 EY flow or required environmental flow.

In existing developed areas, it may be desirable to bypass a larger amount than the 1 EY flow if a chosen site has insufficient capacity to attenuate both the major and minor system design storms. However, the level of flow bypassed should not exceed the downstream minor system design AEP.

11.26.3.2 *Primary Outlet*

To achieve the design flow control requirements, the primary outlet configuration will generally consist of a multi-outlet structure, or several outlet structures combined to provide multi-stage outlet control.

The Designer shall ensure that the stage-discharge relationship adequately reflects the range of different flow regimes that the structure will operate under. The outlet hydraulics for multi-outlet structures may be complicated and difficult to analyse. Care must be taken to ensure that the stage-discharge relationship adequately reflects the range of different flow regimes that the structure will operate under. In some cases, particularly if the consequence of failure of the structure is high, the stage-discharge characteristics may need to be verified by physical modelling.

Primary outlets shall be designed to minimise the risk of blocking. The consequences of partial blockage of primary outlets shall be investigated and accounted for in the basin design if found to be significant.

Where a headwall or an open type structure is provided at the entrance to an outlet, consideration must be given to minimising the effect of vortex on the entrance to the outlet to maximise hydraulic efficiency. The need for venting of the outlet must also be investigated.

Pipe systems shall contain the design flow through the detention basin wall and be suitably protected to prevent infiltration of water between the pipe outer surface and the basin wall.

Consideration must be given to the need to protect the toe of the basin embankment and the bed and banks of the downstream waterway from erosion by high velocity outlet discharges.

11.26.3.3 *Secondary Outlet*

A secondary outlet to allow a non-catastrophic means of failure above the 1% AEP event shall be provided. The most common outlet is a high-level weir crest and overflow spillway. Spillway design criteria shall be based on the Australian National Committee on Large Dams (ANCOLD) publications and guidelines by the NSW Dam Safety Act 2015.

The high-level outlet to any detention basin must have a capacity to contain the 1% AEP flood event. Additional spillway capacity may be required due to the hazard category of the structure. The hazard category must be determined by reference to ANCOLD publications and guidelines by the NSW Dam Safety Act 2015.

The design water level of the emergency spillway, when in operation, shall have a minimum 500mm freeboard to the floor levels of dwellings.

The surfaces of the embankment and secondary outlet (normally an overflow spillway) must be protected against damage by scour when subject to high velocities. An open stilling basin may be considered at the bottom of the spillway prior to discharge into the downstream waterway.

11.26.4 *Embankment and Floor Slopes*

Retention basin embankment slopes shall generally have a maximum batter of six horizontal to one vertical (6:1). This is for operational maintenance work health and safety reasons. The design of the basin embankment shall be verified by a suitably qualified geotechnical /civil engineer.

The floor of the basin shall be designed with a minimum fall of fifty horizontal to one vertical (50:1) to minimise the likelihood of ponding.

11.26.5 Safety

It is inevitable that people will have access to a detention basin, especially if it is designed for multi-purpose usage. A detention basin must be designed with public safety in mind both when the facility is in operation and also during periods between storms when the facility is empty. Measures to prevent and discourage the public from being exposed to high-hazard areas during these periods shall be incorporated into the design, based on a risk assessment methodology.

The Designer must consider the following safety measures in the basin design:

- Provision of industry appropriate signs that clearly indicates the purpose and potential danger of a basin during storms. Signs must be located such that they are clearly visible at public access points and at entrances and exits to outlet structures.
- Gratings and trash racks at the inlet of a primary outlet structure shall ensure that a person will not be held under the water against the grating or trash rack. These must be inclined at an angle of 60 degrees to the horizontal and placed a sufficient distance upstream of the inlet to a location where the velocity through the rack is low.
- Safety fencing on steep or vertical drops, such as headwalls and wingwalls, at the inlet and outlet to a primary outlet structure to discourage public access. Safety fencing can also prevent a person inadvertently walking into or falling off these structures during periods when the basin is not in operation.
- Screening of outlet structures with bunds or shrubs to reduce their attraction potential to playing children or curious adults during periods that the basin is not in operation.
- Side slopes shall be a maximum of six horizontal to one vertical (6:1) to allow easy egress
- Water depths shall be, where possible, less than 1.2m in the 5% AEP storm event. Where this requirement is not practical or economic, greater depths may be acceptable. In that case the provision of safety refuge mounds must be considered.
- Depth indicators must be provided indicating maximum depth in the basin.

11.26.6 Landscaping

Wherever possible, designs must incorporate naturally shaped basins with landscaped banks, and selective planting of vegetation to help enrich the area and provide a focal point for surrounding development. Design shall ensure that the inlet and outlet capacity is not inhibited, and maintenance costs are minimised.

Trees and shrubs shall not be planted on basin embankments as they may increase the danger of embankment failure by 'piping' along the line of the roots.

11.26.7 Access

Retention basins shall be provided with adequate access for its intended and secondary use and maintenance machinery to remove silt or debris from the floor of the basin. Access for maintenance shall also be provided to the primary and secondary outlets.

11.27 On-site Stormwater Detention

The purpose of stormwater detention in the urban space is to protect the downstream properties from the extra flow generated due to the developments. Stormwater Detention may be required for any development site. Council prefers centralised detention basins for

subdivisions. Lot wise individual basins are not accepted for subdivisions with 6 lots/units or over.

Detention not required:

- For demolish and rebuild (not increasing imperviousness over 10%).
- For lots where detention has been provided during subdivision.
- Not exceeding the Permissible Site Discharge (PSD) where PSD is provided within Council's flood study.

In all other cases detention may be required, especially subdivision of an existing lot. For all situations, the maximum discharge for 20% to 1% AEP storm shall not exceed all of the following:

- Pre-development discharge.
- Permissible site discharge (PSD) where PSD is provided within Council's flood study.
- Downstream capacity.

The contributing catchment and the capacity of the downstream drainage system shall be assessed in the design of the discharge points and detention system.

Underground Detention:

- Underground detention system is not allowed except for:
 - CBD areas –when above ground storage is not feasible.
 - Strata subdivisions - when above ground storage is not practicable due to safety.

Only where there exists an adjacent underground stormwater system capable of accepting stormwater through a gravity system. Detention requirements are applicable to urban developments. However, these developments will be assessed on a case-by-case basis. Any developments near the catchment outlet, if downstream properties are not affected are exempt from detention requirements.

Post development discharge is not to exceed Pre-development discharge.

The following Table 26 is to act as a general guide for detention types.

Table 26: General Guide for Detention Types

Size of Development	Detention Type
Subdivision up to 5 Lots or 5 units.	Any suitable method
Subdivision with 6 lots/6 units and over.	Centralised basins are required Land dedication, ownership and maintenance responsibilities of the centralised system will be assessed on a case-by-case basis. No separate decentralised basins will be considered
Strata subdivisions within 1km of town centres (lot number criteria apply).	Centralised basin, under or above ground, will be assessed on a case-by-case basis.

Size of Development	Detention Type
Commercial development in town centres	Centralised, under or above ground
Industrial subdivisions	Centralised preferred, lot-wise may be considered for lots $\geq 4000\text{m}^2$
Must discharge to Council's drainage network or natural channels. The developer must build the necessary drainage along with the development works	

For catchments where risk management plans are developed, please follow the recommendations.

For details, please contact the Development Engineer and refer to Council's website.

The basins shall be routed with longer duration storms (up to 6-9 hours) depending on the catchment area using routing software. Hand calculations will not be accepted. The inflow and outflow hydrographs must be shown.

Rainwater tanks:

- BASIXs rainwater tanks are not considered as flood retardation measures. Additional storage capacity can be considered as detention if appropriately designed.

Pump-out System:

- Pump out system or surcharging on road are not permitted. Council may consider pump out system when no other alternative solutions are available. Sub-divisions for areas without Council drainage system will be allowed provided that the developer provides adequate drainage up to a safe discharge point.

Infiltration system:

- Infiltration systems are not considered as detention for storms 0.2EY to 1% AEP.

Charged system:

- Not acceptable, may be considered in exceptional circumstances where it does not affect any property or traffic.

SQID as Detention:

- No Stormwater Quality Improvement Devices (SQIDs) will be considered as detention/retention methods. These are grassed swales, rain gardens, rainwater tanks (some exceptions), buffer strips, infiltration trenches etc.

On-site stormwater detention (OSD) may be required for individual building developments and on redevelopment sites to attenuate the runoff to discharge levels expected from the pre-developed site for the major and minor storm events.

The stormwater drainage design shall ensure that the works do not create or worsen any capacity problems in the existing public drainage system.

On-site detention (OSD) will not be required for a development where the subject property is demonstrably affected by the 20% Annual Exceedance Probability (AEP) flood event (i.e., inundated or part of an overland flow path during the 1 in 5-year event). In such cases, the development may discharge directly to the lawful point of discharge without an OSD system, subject to Council's confirmation of flood extent/inundation and compliance with other stormwater management requirements including conveyance and freeboard.

On-site detention calculations shall include any upstream catchments which contribute to the runoff. The use of on-site stormwater detention within lower catchment areas shall be assessed to ensure it does not adversely impact peak flows within the public system.

Various storm intensities and temporal patterns/durations shall be modelled to determine the critical storm event both pre-development and post-development. The on-site detention system must be designed to limit post-development flows back to pre-development flows for all design storms up to and including the 1% AEP. A runoff routing method must be used in the design and analysis of the proposed system.

The temporary storage of water shall be contained within the site and is not to encroach onto adjacent properties or public and road reserves. Pedestrian access is not to be included within the storage area unless readily available alternative routes are provided.

The on-site detention is not to be located within private courtyard, drainage easements, or secondary flow paths.

The maximum water depth for the 1% AEP event is 200mm for car parks and 600mm for gardens.

An overland flow path (or spillway) must be provided for the on-site detention area. A minimum freeboard of 500mm must be provided to floor levels (including adjacent properties) for the 1% AEP event, assuming 100% blockage of the piped discharge.

The piped discharge from the detention area is to connect directly to the street drainage system, Council drainage easement, and/or an interallotment drainage system that discharges to a public stormwater system. However, other discharge locations may be considered.

11.28 Major Structures

11.28.1 General

A major drainage structure is defined as a structure that will convey flow 10 cumecs or greater.

Minor structures are all structures not defined as major structures.

All major structures shall be designed for the safe passage of the 1% AEP without afflux in urban areas.

Certain level of afflux may be permitted if no property is affected.

Clearance for major Structures:

- 0.3m for 1% AEP (between water level and soffit of the structure).

Structural design: For major/minor structures shall be carried out in accordance with AUSTRROADS Bridge Design Code by qualified structural engineers.

Rock sizes: For scour protection should be determined based on velocity in 1% AEP event in accordance with the latest version of Queensland Urban Drainage Design Manual (QUDM) or any other published material.

Rock protection shall be angular and granite/basalt in origin, no sandstones can be used.

11.28.2 Box Culverts

The minimum box culvert size shall be 450mm x 450mm. The preferred minimum height shall be 450mm considering blockage. 300mm high box culverts may be considered for lengths less than 10 metres.

Box culverts may be used where available depth to invert is restricted or to provide maximum waterway area and minimum obstruction to flow.

Blockage Factors for Culverts:

- The blockage factors must be considered in designing culverts. Please refer to Australian Rainfall and Runoff Project 11, Blockage of Hydraulic Structures, IE Australia.

All other drainage structures such as flood protection levee banks, constructed wetlands, prescribed dams and infiltration devices shall be designed in accordance with the relevant Australian Standard and industry guidelines and approved by Council's Representative.

11.29 Remote Supervision Signage

Areas such as wetlands and detention basins are to be sign posted in accordance with remote supervision guidelines/best practice notes as issued by Council's insurer. Copies of these guidelines can be issued upon request.

11.30 Work-As-Executed Stormwater Works

11.30.1 Work-As-Executed Documents

Work-as-executed drawings: Provide an additional set of final construction drawings for the purpose of recording the work completed by the Contractor. Provide all required data and electronic files as outlined in the HC Engineering guidelines under Work as Executed plans specification requirements.

11.31 Final Certification of Completed Works

Requirement: Council requires the designer or its representative to carry out sufficient site inspections to validate the final certification of the proposed works. Completed works: The designer to provide evidence that the site inspections were undertaken during construction works and provide final certification that the completed work is consistent with the approved design.

12 Control of Erosion and Sedimentation

12.1 Introduction

This sub section application is applicable to the design and documentation requirements of control measures for mitigating the effects of erosion and sedimentation from construction activities and stormwater run-off, as required for the development erosion and/or sediment risk level. It includes both temporary and permanent control measures.

12.2 Responsibilities

General Requirement: Provide design and documentation for temporary and permanent erosion and sedimentation control measures to minimise short and long term soil erosion and the impact of erosion.

Interpretation Abbreviations General: For the purposes of this sub section the following abbreviations apply:

- ARI: Average recurrence interval.
- ESC: Erosion and sediment control
- ESCP: Erosion and sediment control plan.
- GPT: Gross pollutant trap.

12.3 Definitions General

For the purposes of this sub section the following definitions apply:

- Average recurrence interval: The average or expected value of the period between exceedances of a given discharge, it is generally expressed in years.
- Catchment (area): A topographically defined area drained by a stream, river or reservoir of water (into a groundwater system).
- Clean water: Water conforming to one of the following:
 - Water that enters the development site from an external source and has not been further contaminated by sediment within the site.
 - Water originating from the site and does not require treatment to reach the required water quality level.
 - Water that would not be further improved if it was to pass through the sediment trap for the site.
- Erosion control measures: Measures to prevent or reduce soil movement from wind, rain or flowing water from a construction site resulting from both natural processes and human activity.
- Low gradient flow diversion (drainage) technique: A flow diversion drain, channel or bank with a gradient sufficiently low to maintain subcritical flow along its length.
- Permanent control measures: Measures/works implemented to control run-off water quality beyond the construction and maintenance stages.
- Rainfall erosivity: The R-factor is a measure of rainfall erosivity and is defined as the mean annual sum of individual storm erosion index values, EI_{30} , where E is the total storm kinetic energy and I30 is the maximum 30-min rainfall intensity. It is measured as

(MJmm/ha/hr). When factors other than rainfall are held constant, soil losses are directly proportional to the magnitude of rainfall erosivity. The R-factor represents the climatic influence on water related soil erosion, and can be used to quantify broad-scale, climate-driven, soil erosion potential.

- Sediment control measures: Measures to reduce the impact of erosion by trapping and retaining sediment before it is discharged into the surrounding environment. Flowing sediment is captured and held in place long enough for it to settle.
- Steep gradient flow diversion technique: A flow diversion drain, channel or chute with gradient sufficiently steep to cause supercritical flow within its length.
- Sub-catchment: A topographically defined area drained by a tributary or branch drain of a primary stream, river or main draining catchment.
- Temporary control measures: Measures required to control and filter the run-off from areas disturbed by the contractor's activities.
- Unsealed road: A road surface that comprises of either natural parent material or gravel added and is not surfaced by bitumen or concrete.

12.4 Qualifications

Expertise: Use suitably qualified or experienced personnel to assess the erosion risk level of the development site and prepare the ESCP.

12.5 Pre-design Planning

12.5.1 Planning

12.5.1.1 Key Characteristics

General: The principles of erosion and sediment control for urban development equally apply for unsealed roads, but some key differences relating to planning, design, construction and maintenance for unsealed roads include:

- They are linear and produce large amounts of sediments in stormwater runoff and can cause serious environmental damage on reaching waterways.
- Cross multiple catchments and have various discharge points making effective sediment control measures difficult to implement.
- Control of erosion and sedimentation are required at all stages of construction and ongoing maintenance to minimise erosion, sediment and pollutant transport.
- Specific works like bridges, culverts, causeways and borrow pits, road safety and constructability may influence the selection and location of erosion and sediment control measures.
- Management of roadside drainage in controlling sediment runoff, with an emphasis on slowing drainage flows and dispersing them more frequently.
- Roadside vegetation in maintaining good stormwater quality by slowing and filtering stormwater runoff.

12.5.1.2 Data Collection

Requirement: Collect data required for assessing the development site erosion risk level and for preparing the erosion and sedimentation management strategies for the development.

Erosion risk assessment: Collect site data required to inform the risk assessment, including the following:

- Geotechnical investigation: To AS 1726.
- Soil data: From soil maps or, if this is not available, from soil sampling and testing. Identify soil properties such as soil type, erodibility, dispersion potential, salinity, shrink swell capacity, texture and drainage characteristics. If required by a regulatory authority or if the development involves varied and complex land use where changes are expected, prepare a soil survey to identify the existence of problematic soils.
- Site constraints and attributes: Including the following:
 - Topography and landform: Slope, gradient and aspect.
 - Lithology: Rock outcrops and substrate material.
 - Climate and hydrology: Rainfall, flood liability, groundwater level and rainfall erosivity.
 - Vegetation.
- Area of disturbance or prone to mass land movement.
- Distance of site to existing drains/watercourses.
- Areas with drainage problems. Erosion and sedimentation strategies: Collect site data to assist in preparing management strategies, including the following:
 - Site properties/constraints and development impact data to assist in the selection and design of drainage, erosion and sediment control measures, including identification of the following:
 - Site contour.
 - Off-site and on-site hazards.
 - Potential impacts of the development.
 - Potential site constraints, including soils, topography, water supply and vegetation.
 - On-site natural watercourses and receiving water such as creeks, ponds, lakes, wetlands, waterways, swamps, springs and artesian features.
 - Potential flood prone land.
 - Critical environmental habitats.
- Nature of land disturbance resulting from the proposed development.
- Site and development data to assist in the design of site revegetation.
- Soil treatments required to facilitate site revegetation.
- Natural drainage paths on the site.
- On-site water quality levels/values and discharge standard.
- Non-erodible areas and potential diversion routes.
- Locations of potential dispersive soils.
- Areas of potential landslide/mass movement.
- High and extreme erosion risk areas requiring protection.

- Areas with soils of extreme pH and/or requiring amelioration.

12.6 Site Erosion Risk Assessment

Risk level assessment: Determine the development site erosion risk level by calculating the predicted total soil loss from the site over the total period the site will be disturbed, e.g. 6 months. Use the Council's risk class or scale criteria to determine the site erosion risk level.

Higher risk areas on site: Identify areas with higher risk so that management measures can be addressed at the planning stage. These areas include the following:

- Areas with high potential for soil loss.
- Areas with high potential to cause environmental harm.
- Areas located within or within close proximity to critical habitats such as wetlands, creeks and waterways.
- Areas with monthly rainfall erosivity (R factor) more than 285.
- Areas affected by high-risk construction activities, including the following activities:
 - Which disturb natural wetlands or flowing streams.
 - Which disturb threatened species and habitats.
 - Which disturb protected vegetation.
- With the potential to cause significantly more soil loss and/or environmental harm.
- Which run longer than 6 months.

12.7 Site Sediment Risk Assessment

Risk level assessment: Determine the development site sediment risk level based on predicted soil loss from the site over the total period the site will be disturbed for determining sediment control methods required for the site.

12.8 Land Capability Assessment and Site Actions Required

Requirement: Determine site/land/urban capability based on extent of land disturbance required by the development, and water erosion and water pollution risk.

Areas requiring remedial action: Identify existing areas subject to erosion, where remedial measures are required.

Severe rainfall: If severe rainfall events are expected, prepare a contingency plan.

12.9 Consultation

12.9.1 Council and Other Authorities

Council consultation: Liaise with the Council's Development Control officer(s) for the following:

- Soil and contour mapping.
- Vegetation mapping.
- Tree/vegetation subject to statutory protection.

- Flood prone areas.
- Council's policy and Development control plans for ESCP requirements for erosion and sediment control, and stormwater drainage.

12.9.2 Procure Approvals as Required

An erosion and sedimentation control concept plan for all stages of the project shall be prepared and submitted to Council for approval. The approved concept design shall be included in the Drawings for the project.

Other authorities: Consult with and seek approval for the scheme development from the state government authorities responsible for the following:

- Bushland areas.
- Wetlands.
- Waterways
- Catchment water quality.

12.9.3 Other Project Development Team Members

Other development project design team members: Identify high risk areas as early as possible in the project development and liaise with other members of the design team to address the control measures in the project concept design so that risks and hazards can be mitigated or eliminated.

Integrated development planning: In particular, liaise with members of the development design team preparing the design of the following:

- Works in or close to a watercourse.
- Layouts of lots, roads, cycleways and pedestrian pathways.
- Recreational facilities, open spaces or natural heritage reservations.
- Stormwater drainage systems.
- Services installations.
- Site rehabilitation.

12.10 Design Criteria

12.10.1 Classification of Unsealed Roads

General: To Austroads AGRD02 Table 2.2.

12.10.2 Design Objective

Requirement: Design erosion and sediment control measures for the proposed development with the following objectives:

- Integration of measures with the site and construction planning.
- Compatibility with the anticipated soil, weather and construction conditions.
- Minimisation of the extent and duration of soil disturbance, with limitations on the time surfaces are exposed.

- Control water movement through the site.
- Minimisation of soil erosion. Prompt stabilisation of disturbed areas. Maximisation of sediment retention on the site.
- Measures are functional at all times.
- With monitoring measures to maintain the required performance standard.
- ESC measures are appropriate for the environmental risk; type, cost and scope of proposed development.
- Ensure that maintenance considerations are included as an essential design element

Design considerations: Address all aspects of site disturbance, stormwater management, erosion and sediment control, and site rehabilitation for the duration of the construction from initial clearing to project completion.

12.10.3 Location of Unsealed Roads

For new unsealed roads: Select the location considering the following factors:

- Locate the road along a ridge or as high as possible on side slopes to reduce the catchment area above the road or track.
- Minimise disturbance to soil and vegetation.
- Minimise the number of watercourse and drainage line crossings.
- Avoid steep cross-slopes (greater than 18 degrees).
- Avoid high erosion hazard soils (e.g. dispersive soils, soil loss classes 5, 6 and 7).
- Avoid areas of riparian vegetation and maintain buffer strips between the road and any watercourse.
- Avoid areas where there are perched water tables, swamps, or areas of poor drainage.
- Avoid areas prone to mass movement or slope stability problems.
- Avoid soil types having poor construction quality.

12.11 Development Planning Considerations

12.11.1 Construction and Site Planning

Control measures and staging of works: Design type, location, and timing of measures and actions in relation to the disturbance activities for each phase of work, including clearing, earthworks, civil construction, services installation and landscaping/rehabilitation. Design the measure/action to minimise erosion, manage flow and capture sediment in relation to the construction and access areas at each phase of work.

Protection measures: Provide measures based on the following requirements:

- Existing buffer zones protecting the site.
- Sensitive natural and indigenous features requiring protection.
- Fencing and isolation measures required to protect features including habitats.
- Temporary drainage works required to divert water and sediment through works in progress.

- Site conditions: Apply the appropriate site conditions for designing run-off control measures to withstand storm event.

12.11.2 Development Planning

Integrated development planning: Review proposed development layout and coordinate soil and water management with engineering requirements. If required, modify development layout to:

- Minimise land clearing and land shaping.
- Minimise the risk of erosion within downstream waterways.
- Minimise changes to the volume, frequency, duration and velocity of stormwater run-off affecting the natural water cycle.
- Minimise earthworks and construction activities along property boundaries.
- Allow disturbance areas to be permanently stabilised. So that non-disturbance areas can act as sediment control buffer zones.
- Allow for early installation and operation of permanent stormwater drainage system.
- Avoid placing critical structures or buildings in regions with the lowest land elevation.
- To integrate identified site constraints.
- Risks that cannot be eliminated as part of the design: Develop measures to control/ reduce or eliminate the risks.

12.11.3 State Legislation

Comply with the following:

- NSW Gov Act No. 26 - *Dams Safety Act 2015*
- NSW Gov Act No. 30 - *Local Government Act 1993*
- NSW Gov Act No. 156 - *Protection of the Environment Operations Act 1997*
- NSW Gov Act No. 10 - *Soil Conservation Act 1938*
- NSW Gov Act No. 44 - *Water Act 1912*

12.11.4 State Guidelines and Other Referenced Documents

- Refer to the following:
- Landcom “Blue Book”. Landcom Publication; current publication.
- Managing Urban Stormwater: Soils and Construction Vol 1, Landcom 2004-Latest Edition
- NSW SOIL CONSERVATION SERVICE Manual 2017 Fire Trail Design, Construction and Maintenance.
- AS 1726 Geotechnical site investigations
- Austroads AGRD Guide to road design current issue
- Austroads AGRD02 –Design Considerations current issue

12.11.5 Site Evaluation Tools

Requirement: If required for the development, an appropriate mapping tool to determine the suitability of the proposed development for the site as follows:

- Site/land/urban capability mapping: To assess land use (for the development) through soil investigation.
- Erosion risk mapping: Include mapping of site constraints that directly relate to soil erosion and zones of various erosion risks. Base the selection/design of control measures on the assessed risk.
- Erosion hazard assessment: Use a system appropriate for the development, to assess all the erosion hazard items affecting the erosion risk level of the proposed development, e.g. average slope of disturbance area, duration of soil disturbance, climate, topography, geology, drainage and surface hydrology.
- Available contour mapping.

12.12 Site Constraints

Requirement: Design development layout and erosion control measures to reflect known site constraints and regional factors.

Soil limitations: From the soil data collected, assess the potential and limitations of soils for the proposed development and soil management measures required for the site. If a soil survey has been prepared, use the survey to assess the appropriateness of land use proposed by the development; plan, design grading and erosion control measures for the development; make recommendations for soil treatments and allow for soil management technique such as vegetation selection.

Topographic limitations: Minimise land reshaping, utilise the existing topography where practicable and where appropriate, address the following topography regions in the development design and layout:

- Drainage problem areas.
- Areas with existing erosion problems.
- Flood prone land.
- Land prone to mass movement erosion.
- Rock outcrops.
- Steep slopes.
- Wetlands.

Water limitations: Determine the expected seasonal water quality, quantity and supply cost. If required, allow for sediment basins as a temporary water supply for dust control and plant irrigation.

Vegetation limitations: Consider the following in the development design and layout: Retention or rehabilitation of critical areas such as watercourses, floodplains, steep slopes or wetlands with natural vegetation cover for soil stabilisation.

Selecting trees for preservation before locating roads, buildings and open works.

Locate roadways, construction storage areas and parking bays away from the drip zone of trees (Tree Protection Zone) selected for preservation.

Avoid excavation, traversing, filling, trenching within the drip zones of trees selected for preservation.

Retain existing ground cover on slopes steeper than 10% and deep rooted vegetation on slopes steeper than 20%.

Ecological limitations: Consider any adverse effect the erosion and sediment control measure selected may have on the natural ecology of the site. For example, reinforcing mesh applied in bushland areas may cause native fauna (birds or ground dwelling reptiles) to become entangled.

12.13 Drainage Control

12.13.1 Design Standards

Permanent drainage design: To Section 11 Stormwater Drainage Design.

Drainage design standard for temporary drainage works.

For anticipated design life of temporary drainage works see Table 27 below:

Table 27: Anticipated Design Life of Temporary Drainage Works

Drainage Structure	ARI Based on the Anticipated Design Life		
	< 12 months	12 to 24 months	> 24 months
Temporary drainage structures ¹ : NSW.	1 in 5 year	1 in 10 Year	1 in 10 Year
Temporary drainage structures ^{19, 20} : Located immediately upslope of an occupied property that may be adversely affected by the failure of the structure (e.g. catch drain, flow diversion bank)	1 in 10 Year	1 in 10 Year	1 in 10 Year
Temporary culvert crossing	Minimum 1 in 1-year hydraulic capacity wherever reasonable and practicable.		

12.14 Drainage for Unsealed Roads

Requirement: Design road drainage to divert the stormwater away from the road by minimising the sediment load by slowing the drainage flows and dispersing them more frequently.

Drainage design for unsealed roads applications include:

- Pavement surface drainage.

¹⁹ Design capacity excludes minimum 150mm freeboard.

²⁰ Design flow rate based on upslope drainage structures, excluding freeboard.

- Table drains.
- Catch drains and batter slopes.
- Culverts and pipes.
- Causeways
- Creeks and drainage line crossings.
- Road drainage in areas with high water tables.
- Road drainage in semi-arid and arid areas.

12.14.1 Maximum Distance of Water Flow Along Unsealed Road Surfaces

The Table 28 below displays the desirable maximum distance of water flow along road surfaces and table drains prior to diversion into paddock or road culverts.

Table 28: Maximum Distance Water Flow Along Road and Table Drains

Road Longitudinal Grade (Percentage)	Maximum Distance (metres)	Road Longitudinal Grade (Percentage)	Maximum Distance (metres)
2.0	250	14	70
3.5	200	16.0	65
5.0	150	17	60
7.0	125	19.5	55
8.5	100	21.0	50
10.5	90	12.0	45
12.0	80	25.0	40

(Source: NSW State Office of Environment and Heritage).

12.15 Drainage Control Measures

Requirement: Allow for control measure to suit the site drainage gradient/slope, drainage surface and function required.

Low gradient drainage technique: Select from the following measures:

- Catch drain.
- Compost berm.
- Diversion channel.
- Flow diversion bank – earth, sandbags.
- Coir logs.
- Aggregate berms.

Drainage down slopes, steep gradient flow diversion technique: Select from the following measures:

- Chute.
- Level spreader.
- Slope drain.

Outlet structures for temporary drainage systems: Select from the following measures:

- Level spreader.
- Outlet structure.

Velocity control structures for channels and drains:

- Design drainage channels so that the maximum flow velocity does not exceed that allowed for the surface material to minimise channel erosion (nominally no more than 3m/sec for a couch/kikuyu lining), including along the invert. If channel width, depth or gradient cannot be altered, control invert erosion through the following options:
 - Reducing flow velocity through check dam placement.
 - Increasing effective scour resistance of the drain by incorporating channel liners such as erosion mats or rocks.

Check dam techniques: Select from the following measures:

- Fibre roll.
- Rock/large aggregate check dam.
- Recessed rock check dam.
- Sandbag check dam.
- Triangular ditch check.

Channel/chute lining techniques: Select from the following measures:

- Cellular confinement system.
- Erosion control mats.
- Geosynthetic lining.
- Grass lining (sown).
- Grass pavers.
- Hard armouring.
- Reinforced grass.
- Rock lining.
- Rock mattresses.
- Turfing.
- Turf reinforcement mats.

Drainage control on unsealed roads: Select from the following measures:

- Discharge of water as sheet flow:
 - Level spreader.

Drainage from unsealed access roads:

- In-fall drainage.
- Out-fall drainage.
- Crowned road pavement profile.

Temporary watercourse crossings: Select from the following measures:

- Bridge.
- Culvert.
- Causeway/Ford.

12.15.1 Control Measure Selection Considerations

Sandbag check dams: Allow in drains shallower than 500 mm.

Rock check dams: Allow in drains deeper than 500 mm.

Track drainage: Refer to NSW Rural Fire Service – Fire Trail Design, Construction and Maintenance Manual

Stripped topsoil: Where possible re-use stripped topsoil to form flow diversion banks upslope of the soil disturbance.

Watercourse crossings: Design watercourses to filter run-off through surrounding grass or bushland before it enters streams.

Temporary culvert crossings: Design crossing so that head loss across the structure is limited to 300 mm maximum at the point when overtopping first begins to occur.

Long unstable slopes: Subdivide into manageable areas to prevent rill erosion.

12.16 Erosion Control

12.16.1 Risk Assessment

General: Develop and adopt local risk assessment procedure. Alternatively adopt the erosion risk rating based on average monthly erosivity, or average monthly rainfall depth or on the estimated soil loss rate as appropriate.

Erosion risk rating and predicted soil loss is shown in Table 29.

Table 29: Erosion Risk Rating and Soil Loss

Erosion Risk Rating ²¹	Average Monthly Erosivity (R-factor)	Average Monthly Rainfall (mm)	Soil Loss (t/ha/yr)
Very Low	0-60	0-30	0-150
Low	60-100	30-45	150-225
Moderate	100-285	45-100	225-500
High	285-1500	100-225	500-1500
Extreme	>1500	>225	>1500

12.17 Erosion Control Measures

Soil stabilisation techniques: Select from the following measures, as appropriate for the site erosion risk assessment:

- Bonded fibre matrix.
- Cellular confinement system.
- Compost blanket.
- Erosion control blanket.
- Gravelling.
- Heavy mulching.
- Light mulching.
- Revegetation.
- Rock mulching.
- Soil binders.

12.17.1 Mulching

Requirement: Select light or heavy mulching for soil stabilisation and to prevent soil crusting of non-vegetated areas or areas where garden beds are proposed on flat or mild slope.

Light mulching: Select from the following measures:

- Bonded fibre matrix.
- Brush mulch.
- Dead or dormant grass cover (temporary seeding).
- Hydromulch.

²¹ Risk rating categories are defined in IECA Book 1 Table 4.4.7 Best practice land clearing and rehabilitation requirements

- Straw mulching including sugarcane mulch.

Heavy mulching: Select from the following measures:

- Brush, bark, woodchip mulch.
- Compost blanket.
- Rock mulching.
- Straw mulching including sugarcane mulch.

Grass seeded areas: Allow for protection from raindrop impact erosion with light mulch immediately after seeding.

12.17.2 Erosion Control Blankets

Requirement: In areas of strong winds or overland flows, allow for erosion control blankets as an alternative to loose mulching or for stabilising mulch from washing or blowing away. Select from the following measures:

- Hydraulically applied blankets.
- 100% biodegradable jute and coir blankets.
- Jute and coir mesh.
- Short-term synthetic reinforced composite blankets (must be removed from site after short term use – micro plastic source).
- Permanent turf reinforcement mats.

12.17.3 Control of Soil Erosion on Slopes

Requirement: Consider the following practices when designing erosion control measures for soil areas that are sloped:

- Establishing non-erosive drainage conditions for periods when rainfall may occur.
- Establishing 70% of soil surface for periods when rainfall may occur.
- Establishing complete and continuous vegetation cover.
- Slopes that are likely to be vegetated: Allow for slope to be as flat as possible to reduce the shear stress of the slope from stormwater run-off.
- Slopes that are unlikely to be vegetated: Allow for slope to be as steep as possible to reduce exposure of slope effective surface area to raindrop impact erosion.
- Steep grass seeded slopes: Allow for turf strips to be pinned along the contour in maximum 2 m spacing to maintain sheet flow down the slope and reduce the risk of rill erosion.

12.17.4 Summary Application of Erosion Control Measures to Soil Slopes

For a summary of various applications of erosion control measures to soil slopes, see Table 30.

Table 30: Application of Erosion Controls to Soil Slopes

Flat Land (flatter than 1V:10H)	Mild Slopes (1V:10H to 1V:4H)	Steep Slopes (steeper than 1V:4H)
Erosion control blankets	Bonded fibre matrix	Bonded fibre matrix
Gravelling	Compost blankets	Cellular confinement systems
Mulching	Erosion control blankets, mats and mesh	Erosion control blankets, mats and mesh
Revegetation	Mulching well anchored	Compost blankets
Rock mulching	Revegetation	Revegetation
Soil binding	Rock mulching	Rock mulching
Turfing	Turfing	Turfing

12.17.5 Dust Control

General: Dust control treatments vary with site conditions. Select the appropriate treatment from the Dust control practices below and in Table 31.

Wind erosion: To prevent wind erosion, incorporate the following measure(s):

- Revegetation.
- Maintaining moist soil conditions.
- Chemical sealants (soil binders) placed over the soil surface.
- Surface roughening.
- Wind breaks.

Table 31: Summary Dust Control Measures

Site Conditions	Treatment Options						
	Permanent Vegetation	Mulching	Watering	Soil Binders	Gravel Road	Stabilised Entry/Exit Pad	Minimise Site Disturbance
Areas not subject to traffic	✓	✓	✓	✓	✓		✓
Areas subject to traffic			✓	✓	✓	✓	✓
Material Stockpiles			✓	✓			✓
Clearing and Excavation			✓	✓			✓
Unpaved roads			✓	✓	✓	✓	
Earth Transport					✓	✓	

12.17.6 Major Drainage Channels and Watercourse Stabilisation

Stabilisation of disturbed areas: Allow for disturbed areas to be revegetated to the water's edge, to link aquatic and riparian habitats. Stabilise by rock protection during plant establishment.

12.17.7 Vegetation Management

Vegetation management planning: Where site clearing is required, minimise soil disturbance to the development site; and allow for site revegetation to provide short or long term erosion protection to suit the following site properties:

- Natural slope (gradient) of the site.
- Site topography.
- Current and future land use within and adjacent to the site.
- Existing native flora.
- Soil condition, including structure, water holding capacity, nutrient content and dispersion potential.

Vegetation clearing: Plan land clearing operations in conformance with the following:

- So that vegetation clearing does not start before a vegetation management plan is prepared and sedimentation control measures and drainage have been installed.
- Clearing is staged to minimise the extent and duration of soil exposure to wind, rain and running water.
- Clearing is limited to 5 m from the edge of proposed construction works.

Plant selection: Select plants suited to the site erosion likely to occur at the development site. For example, where sheet erosion is likely, ground cover grasses are suitable to provide continuous cover; where wave erosion is likely, reeds are more suitable for creeks and ponds.

Management of problematic soils: Allow for soil protection measures or soil adjustments so that vegetation can establish. If required, allow for erosion control blanket, mat or mesh to protect the soil from short-term erosion during the plant establishment period.

12.18 Sediment Control

12.18.1 Design Standards

Sediment control standard: Design sediment control measures based on the allowable soil loss rate limit (t/ha/yr) or the monthly erosivity (R-factor) and average monthly rainfall for the development site.

Design discharge for sediment traps: Allow for design storm of 0.5 times the 1 in 1 year ARI peak discharge.

12.18.2 Design Objectives

Design criteria: Design sediment control measures in conformance with the following:

- Sediment laden run-off: So that sediment is collected and retained wholly within the development work site and trapped before the run-off moves onto road surfaces.

- Sediment laden run-off originating from the road surface: So that sediment is prevented from entering sealed (e.g. hard lined) drainage systems or permanent drainage systems (e.g. piped or open channel drain).
- Sediment controls within or adjacent to roadside stormwater outlets: Allow for gully bags in preference to road-surface sediment traps.
- Kerb inlet sediment traps: So that inlet traps do not replace sediment traps up-slope of stormwater inlets, as required by the relevant regulatory authority or to suit the current version of Council's Drainage Design Handbook
- Sediment traps at outlets of stormwater pipes: If required, locate downstream of the influence of outlet jetting, 10 to 13 x pipe diameters downstream of the outlet.

Development site environmental protection: Do not rely solely on sediment control measures, consider more efficient and economical means of protection, such as drainage and erosion control measures. Sediment trap locations: Locate sediment traps in conformance with the following:

- Trap efficiency: So that clean water is diverted around the sediment trap to maximise sediment trap efficiency.
- Protection of surrounding environments: So that adjacent properties and downstream environments are protected from the adverse effects of sediment and sediment laden water discharged from the site.

Sediment trap properties: Allow for traps with the following features:

- Able to pond water.
- Adequate retention time so that suspended particles can settle.
- The capacity to collect the required volume of sediment.
- Adequate hydraulic capacity required before start of flow bypassing.
- The maximum depth pooling limits required for public safety.

Straw bales as sediment traps: Do not include in the design unless site conditions prevent the use of other more appropriate sediment control systems.

12.18.3 Sediment Control Measures

In areas of sheet flow: Select from the following measures:

- Buffer zones.
- Compost berm.
- Fibre roll.
- Filter fence.
- Filter sock.
- Filter tube dam.
- Grass filter strip.
- Modular sediment trap.
- Mulch berm.

- Sediment fence.
- Stiff grass barrier.

At kerb inlets: Select from the following measures:

- Gully bag sediment trap.
- On-grade kerb inlet sediment trap.
- Sag inlet sediment trap. .
- Coir Log trap

At field (drop) inlets: Select from the following measures:

- Block and aggregate drop inlet protection.
- Excavated drop inlet protection.
- Fabric drop inlet protection.
- Filter sock drop inlet trap.
- Mesh and aggregate drop inlet protection.
- Rock and aggregate drop inlet protection.

Areas of minor concentrated flow: Select from the following measures:

- Check dam sediment trap.
- Coarse sediment trap.
- Filter tube dam.
- Modular sediment trap.
- Stiff grass barrier.
- U-shaped sediment trap.

In areas of concentrated or instream flow and sediment control techniques: Select from the following measures:

- Cofferdam.
- Filter tube barrier.
- Floating silt curtain.
- Geo lot.
- Isolation barrier.
- Modular sediment barrier.
- Rock filter dam: Filter cloth used as the primary filter medium or aggregate used as the primary filter medium.
- Sediment fence isolation barrier.
- Sediment filter cage.
- Sediment weir.

At entrances to culverts and open stormwater pipes: Select from the following measures:

- Block and aggregate sediment trap.
- Excavated sediment trap.
- Filter sock sediment trap.
- Mesh and aggregate sediment trap.
- Sediment fence (woven or non-woven).
- Sediment weir.

At outlets of stormwater pipes: Select from the following measures:

- Excavated sediment trap.
- Filter tube dam.
- Sediment weir.
- Straw bale barrier.

Dewatering measures: Select from the following measures based on expected flow level:

- Low flow:
 - Sump pit.
 - Filter bag.
 - Filter tube.
 - Grass filter bed.
 - Compost berm.
 - Filter fence.
 - Sediment fence.
- Moderate flow:
 - Filter tube dam.
 - Filter sock.
 - Filter pond.
 - Portable sediment tank.
 - Settling pond or stilling pond.
 - Hydro-cyclone (centrifuge).
- High flow:
 - Sediment basin.

At development site entry and exit points: Select from the following measures:

- Rock pad.
- Vibration grid.
- Wash bay.

12.19 Stockpile Management

12.19.1 General

Location: Locate stockpiles in conformance with the following:

- Clear of existing or proposed drainage works.
- Clear of areas likely to be disturbed during construction.
- Clear of the drip zone of trees.
- On reasonably flat areas.
- At least 5 m from concentrated water flows and at least 10 m from waterways.
- At least 2 m from hazardous areas, retained vegetation and overland paths, especially for stockpiles of fine non-cohesive material.
- Up-slope of an appropriate sediment control system.
- Topsoil stockpiles: Isolate topsoil from subsoil material in separate stockpiles.
- Refer also to the Erosion Control “Blue Book” Managing Urban Stormwater: Soils and construction - Volume 1

12.19.2 Erosion Control Measures

Up-slope stormwater: Design control measures so that stormwater is diverted around stockpiles if the following conditions exist:

- Periods when rainfall is possible.
- Up-slope catchment area: > 1500 m².
- Average monthly rainfall: > 45 mm.

Stockpile protection: Allow for stockpile protection from wind and rain, especially those of clayey soils which are more susceptible to raindrop impact erosion than sand stockpiles.

12.19.3 Sediment Control Measures

Down-slope of stockpiles: Allow for woven sediment fencing or other control measures to suit the stockpile material, for example, sand, gravel, topsoil or subsoil.

13 Documentation

13.1 Submissions Process

13.1.1 Document Submission and Approval Process

Requirement: Submit Erosion Sediment Control Plan or (ESCP)/Soil Water Management Plan (SWMP) depending on the sites size and supporting documentation at the following development design phases:

- Functional layout submission: Include the following as part of the development functional layout submission for approval before detailed design work:
 - Site risk and hazard assessment.
 - Conceptual ESCP/SWMP for high-risk sites.
 - Layout of drainage and roads within and affecting the development.
- Detailed design submission: Include the following as part of the development application/approval submission:
 - ESCP/SWMP and supporting information including soil data, site constraints, erosion risk/hazard assessment, sediment risk assessment and site capability.
 - A catchment map defining sub-catchment boundaries.
 - Documentation showing the preferred location and area requirements of major sediment traps (such as sediment basins) and whether they can be permanently incorporated into the stormwater management system, e.g. detention basins or wetlands.
- Final design submission: After detailed design is approved, submit final design documentation with the following as part of the submission:
 - Final ESCP /SWMP with supporting information for the construction and operational phase.
 - ESCP/SWMP specification.
 - Construction details and drainage plans.
 - Certification documents.
 - Remedial Action Plan (RAP): If remedial action is identified, submit details.

13.1.2 Conceptual Erosion and Sedimentation Control Plan (ESCP) or Soil Water Management Plan (SWMP)

Requirement: Prepare a concept ESCP/SWMP in accordance with the Blue Book.

13.2 Statutory Documentation Requirements

13.2.1 Approvals

Requirement: Document the conditions, advised by the appropriate authority, required to obtain approval of the development for the following:

- Council
 - Functional layout and concept ESCP/SWMP.

- Tree clearing or relocation.
- Stormwater drainage design and water management plans.
- The EPA for other general environmental impact requirements.

13.2.2 Approvals Conditions

Conditions: Document the approval conditions advised by the appropriate authority which contribute to the basis for the design of erosion control measures.

13.2.3 Calculations

Requirement: Provide a design report incorporating the criteria, computer studies, calculations and references supporting the design and maintenance requirements.

13.2.4 Program

Recurrence interval storms: Provide drawings and computer output defining the works and the sequential program to minimise exposure to erosion from ARI storms.

13.2.5 Specifications

Requirement: Refer to Council's Engineering Guideline Specifications.

13.2.6 Design Certification

Requirement: Provide a signed and dated design certificate.

13.3 Drawings

13.3.1 Conceptual Erosion and Sedimentation Control Plan (ESCP) or Soil Water Management Plan (SWMP).

Conceptual ESCP/SWMP drawing content: Include the following on the drawing(s):

- Control measures required based on soil data collected.
- Control measures required based on site constraints.
- Means of feasibly constructing the development whilst protecting the environment.

Requirements for sediment basins on site:

- Adequate space for the construction and operation of major sediment traps and essential flow diversion systems.
- Location of problem soil areas including dispersive soils, acid sulphate soils, areas of potential mass movement.
- Environmental features requiring protection such as vegetation.

13.3.2 Conceptual ESCP/SWMP scale: < 1:1000.

13.3.2.1 ESCP/SWMP

Drawing content: Prepare separate ESCPs/SWMPs for the construction and operational phase for the development incorporating the following but not limited to:

- North point and plan scale.

- Legend of standard symbols used within the plans.
- Proposed development layout, taking into consideration local issues, concerns, site constraints and development approval conditions.
- Site and easement boundaries and adjoining roadways.
- Existing site contours (unless the provision of these contours adversely impacts the clarity of the ESCP/SWMP).
- Final site contours including locations of cut and fill.
- Limits of disturbance.
- Retained vegetation including protected trees. Location and description of existing vegetation.
- Soil information and location of problematic soils. If required, prepare soil maps for the site to identify problematic soils including dispersive and acid sulphate soils, sandy soils and clayey soils.
- Location of all drainage, erosion and sediment control measures.
- Full design and construction details (e.g. cross sections, minimum channel grades, channel linings) for all drainage and sediment control devices, including diversion channels and sediment basins.
- Site revegetation requirements (if not shown on a separate plan).
- Location of potential areas of non-disturbance and critical areas (vegetated buffer strips, drainage lines and structures, water bodies, unstable slopes, flood plains and seasonally wet areas).
- The final limits of disturbance.

Construction phase ESCP/SWMP: Incorporate the following, but not limited to, in the construction phase ESCP/SWMP for the development:

- General layout and staging of proposed works.
- Construction access points.
- Site office, carpark and location of material stockpiles.
- Location and stabilisation measures for temporary construction roads and watercourse crossing.
- Location of access haulage tracks and borrow pits.
- Location of all earthworks including roads, areas of cut and fill and regrading.
- Location of major sediment traps (including truck cleaning facilities where required).
- Controls for clean water run-off, including type and location of diversion works that direct uncontaminated run-off around areas of future disturbance.
- Controls for flow velocities in drains.
- Controls for dirty water run-off.
- Protection of channels and outfall zones.
- Divide the site into hydraulically manageable drainage areas and coordinate this with the construction drainage plans.

- Erosion control measures on disturbed boundary.
- Proposed vegetated buffer strips and no access areas.
- Revegetation program.

13.3.3 Construction Phase Drainage Plans

Disturbances greater than 1500 m²: Prepare construction drainage plans for each stage of the earth works, this can either be part of the ESCP/SWMP or separate drawings showing the following:

- Flow entry and exit points.
- Areas of sheet flow and lines of concentrate flow (including all drainage channels).
- Sub-catchment boundaries.
- All permanent and temporary roads.
- Site contours.
- Location of watercourses.

13.4 Supporting Design Documents

13.4.1 Calculations

Requirement: Provide a design report incorporating the criteria, computer studies, calculations and references supporting the design and maintenance requirements.

13.4.2 Program

Recurrence interval storms: Provide drawings and/or computer output defining the works and the sequential program required to minimise erosion risk from ARI storms.

13.4.3 ESCP/SWMP Specifications

Construction documentation: Refer to Council's Engineering Guideline - Specifications.

ESCP/SWMP specification content: Include the following information but not limited to:

- Basis of design: Development description, estimate of soil loss, erosion and sediment risk assessment.
- Principles to minimise sediment discharge from the site, including:
 - Land clearing.
 - Site management and temporary ESC measures installed at the end of the working day.
 - Watercourse management.
 - Site rehabilitation.
 - Vegetation management, including application rates (or minimum application rates) for mulching and revegetation measures.
 - Soil management including earthworks, topsoil and problematic soils.
 - Dust control.

- Detailed design information of ESC measures: Include information of the ESC measures required for each catchment, such as contributing catchment size for each measure, holding capacity, dimensions, supporting calculations, associated components of the measure (e.g. outlets and emergency spillways). Other requirements such as revegetation techniques, time frame and methods of achieving stabilisation.
- Site monitoring and maintenance program, including the location of proposed water quality monitoring stations.
- Emergency ESC measure (including drainage) and heavy rainfall response and contingency measure.
- Temporary ESC measures in case of impending storms, or emergency situations.
- Inspection and test plans, and procedures for review and/or amendment to the ESCP/SWMP.
- Identification of site responsibilities.
- Construction program and installation sequence for ESC measures.

13.4.4 Design Certification

Certificate: Provide a signed and dated design certificate as evidence that a Professional Engineer has reviewed all the design documents, including erosion and sediment program and plans for the development, and can verify that the designed measures will effectively mitigate sediment migration from the development site.

13.4.5 Additional Certification

- Sites with a soil disturbance greater than 2500 m²: Provide certification by a Professional Engineer that the required SWMP conforms to the following:
 - Satisfies the intent and design/performance standards established by all relevant local, state and federal policies relating to erosion and sediment control.
 - Has been reviewed and approved for construction, soil science, hydrology/hydraulics and site revegetation/rehabilitation included and satisfied.
- Certification by a hydrology and hydraulics Professional Engineer: Required for sites greater than 1 ha or where the ESCP sites incorporate a sediment basin. Certification by a geotechnical specialist: Required if the ESCP/SWMP incorporates a sediment basin with a constructed earth embankment with a height greater than 1m.

14 Street and Public Place Lighting

14.1 General Requirements

Street and public place lighting shall be designed in consultation with the relevant electricity distribution authority (for this LGA, Essential Energy) and in accordance with AS/NZS 1158 Lighting for Roads and Public Spaces, AS 4282 Control of the Obtrusive Effects of Outdoor Lighting, and Council's specific requirements.

All lighting installations intended for dedication to Council shall be designed and constructed in accordance with Essential Energy's current standards, network connection requirements, and approved materials list. The Service Provider shall be responsible for all costs associated with design approval, supply, installation, testing and commissioning of the lighting network in accordance with Essential Energy's requirements.

Lighting shall be provided for the following locations as applicable:

- Subdivision or development roads.
- Intersections, roundabouts, and mid-block traffic calming devices.
- Public areas were nominated in the Development Consent.
- Pedestrian underpasses, overpasses, bridges, ramps, and paths.
- Bicycle parking facilities.
- Car parks.
- Cul-de-sacs, permanent turning heads, and temporary turning facilities.
- Potential vehicle conflict areas and pedestrian and cyclist road crossing locations.

14.2 Design Standards

Lighting design shall generally comply with sub-category P3 or P5 of AS/NZS 1158, unless otherwise approved by Council's Representative. Outdoor Off-Street car parks shall be designed in accordance with lighting sub-category P11 or P12. On intersections with classified roads light design will in accordance with TfNSW requirements.

The following is extracted from Essential Energy's Public Lighting: Installation & Connection Consent CEOF 6127 application form.

Lighting performance and design requirements are grouped into two main categories: Category P – Pedestrian area lighting, where the visual requirements of pedestrians are dominant and Category V – Vehicular traffic lighting, where the visual requirements of motorists are dominant. These are then further categorised into subcategories where the Light Technical Parameters (LTP's) are designed to specifically meet the application. The controlling Road Authority (Hilltops Council, Transport for NSW (TfNSW) or applicable State Agency) is responsible for determining the appropriate subcategory.

To assist controlling Road Authorities in selecting appropriate lighting levels further information can be found in Australia and New Zealand Standard AS/NZS 1158 - Lighting for roads and public spaces. An extract of information from this Standard is outlined below, however Standards change from time to time and both Council and Essential Energy recommends referring to the AS/NZS 1158 document to confirm the most accurate information at the time of completing the relevant application.

Category P

Category P roadway lighting is defined as lighting where the visual requirements of pedestrians are dominant. There are five subcategories within Category P that have specific LTP's that are necessary and sufficient for the application. Table 32 is an extract from AS/NZS 1158.3.1 which explains the selection criteria for each of the Category P subcategories.

Table 32: Subcategories

Type of Roadway or Pathway		Selection Criteria			Applicable Lighting Subcategory
General Description	Basic Operating Characteristics	Pedestrian / Cycle Activity	Risk of Crime	Need to Enhance Amenity	
Collector roads or non-arterial roads which collect and distribute traffic in an area, as well as serving abutting properties	Mixed vehicle and pedestrian traffic	N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3
		Low	Low	Low	PR5
Local roads or streets used primarily for access to abutting properties, including residential, commercial and industrial precincts		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3
		Low	Low	Low	PR5
		N/A	N/A	N/A	PR6*
Common area, forecourts of cluster housing		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3
		Low	Low	Low	PR5

*Generally, subcategory PR6 shall only be applied to the replacement of existing luminaires installed on existing electricity distribution poles or for the initial application of a lighting

scheme where the cost to re-configure these poles limits or precludes compliance with category PR3 and PR5 respectively.

Category V

Category V roadway lighting is defined as lighting where the visual requirements of motorists are dominant. There are five subcategories within Category V that have specific LTP's that are necessary and sufficient for the application. The Table 33 is an extract from AS/NZS 1158.1.1 that explains the selection criteria for each of the Category V subcategories.

Table 33: Category V Subcategories

Typical Applications		Applicable Lighting Subcategory
Description of Road or Area Type	Operating Characteristics	
Arterial or main roads in central and regional activity centres of capital and major provincial cities, and other areas with major abutting traffic generators	Mixed vehicle and pedestrian traffic High to very high vehicle volume High to very high pedestrian volume Moderate to low vehicle speeds Stationary vehicles alongside the carriageway Through and local traffic High traffic generation from abutting properties	V1
Arterial roads that predominantly carry through traffic from one region to another, forming principal avenues of communication for traffic movement, with major abutting traffic generators.	Mixed vehicle and pedestrian traffic High vehicle volume High pedestrian volume Moderate to high vehicle speeds Stationary vehicles alongside the carriageway Through and local traffic High traffic generation from abutting properties	V2
Freeways, motorways and expressways consisting of dividing highways for through traffic with no access for traffic between interchanges and with grad separation at all intersections	Vehicle traffic only High to very high vehicle volumes High speeds	V3

Typical Applications		Applicable Lighting Subcategory
Description of Road or Area Type	Operating Characteristics	
Arterial roads that predominantly carry through traffic from one region to another, forming principal avenues of communication for traffic movement	Mixed vehicle and pedestrian traffic	
	Moderate to high vehicle volume	
	High pedestrian volume	
	Moderate to low vehicle speeds	
	Stationary vehicles alongside the carriageway	
	Through and local traffic	
Sub-arterial or principal roads which connect arterial or main roads to areas of development within a region, or which carry traffic directly from one part of the region to another part.	Low traffic generation from abutting properties	V4 or V5
	Mixed vehicle and pedestrian traffic	
	Moderate vehicle volume	
	Low pedestrian volume	
	Moderate to low vehicle speeds	
	Low traffic generation from abutting properties	

All designs shall utilise best practice energy-efficient lighting with LED luminaires as the mandatory technology, compliant with AS/NZS 1158.6. A minimum efficacy of 120 lumens per watt shall be achieved.

Street lighting is to illuminate the carriage way and also verge areas, especially where a designated footpath/s is provided. Reference is also made to AS/NZS 4282 (Obtrusive effects) and to Councils typical cross section for service utilities in Engineering Guidelines - Standard Drawings.

Consideration for road safety with light column placement and materials having impact absorbing characteristics is also required under safe systems approach.

A minimum design life of 20 years shall apply to all lighting components, except supporting structures where a 40-year design life shall be provided. Design life shall be consistent with Council's adopted asset management standards.

14.3 Solar Lighting – Street Lighting and Pedestrian Areas

Solar lighting may be considered where grid connection is impractical or uneconomical, provided the system demonstrates compliance with AS/NZS 1158.3.1 Lighting for roads and public spaces, Part 3.1 Pedestrian area and achieves equivalent photometric performance to the applicable P-category lighting.

All solar light poles shall have a pole height of 7.5 metres unless otherwise approved by Council's Representative. Design life shall be consistent with Council's adopted asset management standards.

14.4 Poles and Fittings

Only galvanised finished light poles and associated fittings shall be accepted by Council for Council-owned lighting unless otherwise negotiated with Council's Representative.

For lighting assets to be owned and maintained by Essential Energy, poles and fittings shall comply with Essential Energy's current approved product catalogue and coating requirements.

14.5 Rural Road Lighting

Lighting on rural roads is generally limited to intersections, cul-de-sac heads or locations with identified safety risks. The extent and type of lighting shall be determined in consultation with Council's Representative and Essential Energy.

Where reticulated electricity mains are not provided in the vicinity of the proposed road reserve, the Service Provider may install solar powered street lighting in accordance with AS/NZS 1158.

14.6 Responsibilities

It is the Service Provider's responsibility to meet all costs associated with the design, supply, installation, and commissioning of street and public place lighting required by a Development Consent. Council will only accept ownership of lighting infrastructure designed, constructed and certified in accordance with Essential Energy's and Council's requirements.

15 Utility Services Design and Installation

15.1 Design of Utility Services

It is essential to obtain approval from the relevant Roads Authority (Council or in the case of State Roads, TfNSW), before excavating any street or verge. Some Utility/Service Providers may not be required to obtain approval, as a result of legislation or established agreements. Where exemptions apply, Hilltops Council must be notified of the works prior to occurring.

The Designer is to include measures to minimise the risk of any adverse effects of earthworks on existing services including but not limited to:

- Obtaining Before You Dig Australia (BYDA) utility services plans, survey marks and other services information including Council's stormwater, water and sewer information, underground gas, telecommunications and existing electricity supply above and below ground.
- Showing services locations and descriptions on all Engineering Drawings.
- Using specialist Services Locators to confirm locations and depths within the vicinity of the proposed work of all services and noting existing and proposed cover or clearances on Engineering Drawings.
- Providing details of arrangements and contacts for timely adjustments/relocations by services authorities.
- Noting on Engineering Drawings any restrictions on activities near services for the purpose of asset protection.
- Noting on Engineering Drawings the responsibilities and obligations attaching to individuals concerning Services matters.
- Detailing the design of protection works whether temporary or permanent.
- The installation of services in Acid Sulphate Soil (ASS) and Potential Acid Sulphate Soil (PASS) material must be avoided. Where unavoidable ASS and PASS management plans in accordance with the current NSW Acid Sulphate Soil Manuals and Guidelines are required.
- NSW Streets Opening Conference 2018 Edition of Guide to Codes and Practices for Streets Opening.
- Service trenches must be placed in the cut side unless approved by Council's Representative as service trenches in the fill side can create a potential slip plane.
- Attention is drawn to the importance of protecting any State Survey Marks and/or Permanent Marks (SSM and PM) which may be affected by the proposed work. Showing survey marks on all Engineering Drawings and noting plans to protect survey marks in addition to Preservation of Survey Infrastructure (POSI) Survey.
- Detailing temporary and permanent road reserve reinstatement plans.

It is advisable that the Service Provider liaise with Service Authorities at an early stage of the development process to resolve servicing issues such as proposed services layouts, future services, the locations of substations and telecommunications installations and planning regarding existing services alterations or amplifications.

It is advisable that the Designer liaise with Service Authorities at an early stage of the design process to prepare engineering designs which are compatible with the requirements of Council and Service Authorities.

The Service Provider must provide all Service Authorities with finished surface levels and/or up and down measurements from the top of kerb at the proposed property boundary and/or the proposed location of the Service Authorities pit, marker, etc to ensure that:

- All Service Authority conduits, etc have correct cover.
- All Service Authority pits, markers, etc do not require future adjustments to suit driveways, footpaths or similar.

The arrangement of services within verges shall be in accordance with the Hilltops Council Typical utility section located in Engineering Guideline – Section 3 Standard Drawings Part A AND any specific site requirements imposed by Council.

Any area to be disturbed by the provision of services shall be restored to design levels either to new surface treatments when within the site or by reinstatement of existing surface treatments within existing roads and properties.

Refer to Council's Engineering Guideline - Construction Specification Section 7 - Utility Services Installation, Road Opening and Utility Restorations for requirements regarding utility trench installation within road reserves and road reserve reinstatement. Engineering drawings shall be notated accordingly with details to specify remedial works where not adequately covered by Council's Engineering Guideline - Construction Specification.

Where the utility work has significant impact on road pavements the Designer shall consider a full pavement redesign (in accordance with Section 8 - Design of Pavements of this Design Guideline) in lieu of the required trench restoration (as per Engineering Guideline - Construction Specification Section 7 - Utility Services Installation, Road Opening and Utility Restorations).

15.2 Effects on Services

Major public utility adjustments often prevent the proposed works from proceeding because of the costs of relocation. The Service Provider therefore must accurately locate surface and underground utilities in critical locations in respect of type, size, horizontal and vertical placement. This can mean removal of pit lids for inspection, electronic detection and trench excavation for physical exposure of the utilities where site conditions dictate.

Where a utility is unable to be located and/or an assumed depth is adopted than a clear highlighted note is to be provided on the plan view and associated longitudinal section indicating assumed location and depth unknown.

The Service Provider is to include measures to minimise the risk of any adverse effects of earthworks on existing services including but not limited to:

- Obtaining Before You Dig Australia (BYDA) plans, survey marks and other services information including Council's stormwater, water and sewer information, underground gas, telecommunications and existing electricity supply above and below ground.
- Showing services locations and descriptions on all Engineering Drawings.
- Using specialist Services Locators to confirm locations and depths within the vicinity of the proposed work of all services and noting existing and proposed cover or clearances on Engineering Drawings.

- Providing details of arrangements and contacts for timely adjustments/relocations by services authorities.
- Noting on Engineering Drawings any restrictions on activities near services for the purpose of asset protection.
- Noting on Engineering Drawings the responsibilities and obligations attaching to individuals concerning Services matters.
- Detailing the design of protection works whether temporary or permanent.
- NSW Streets Opening Conference 2018 Edition of Guide to Codes and Practices for Streets Opening.
- Service trenches must be placed in the cut side unless approved by Council's Representative as service trenches in the fill side can create a potential slip plane.
- Particular attention is drawn to the importance of protecting any survey marks which may be affected by the proposed work. Showing survey marks on all Engineering Drawings and noting plans to protect survey marks.
- Detailing temporary and permanent road reserve reinstatement plans.

16 Landscaping and Street Tree Planting

16.1 Landscaping

Landscaping may be required by conditions of Development Consent approvals and restoration of civil works. Landscaping, including estate entry features, fencing, mounding or site regrading not shown on the approved Landscaping Plans shall not be undertaken without prior approval by Council's Representative.

Landscaping plans shall be prepared in conjunction with Civil Works Design Drawings and Environmental Assessment and shall be approved by Council prior to the release of a Subdivision Works Construction Certificate or Civil Works Approval.

16.1.1 Landscape Design Objectives

Landscaping designs shall be carried out by appropriately qualified persons. Vegetation and hard landscaping shall:

- Be ecologically sound and sustainable.
- Add value and character to the surrounding environment.
- Integrated with the built and natural environment.
- Avoid root intrusion into road pavements, drainage, sewer and other utilities.
- Avoid uplifting of paving, damage to structures or creating of hazards to pedestrians by tree roots.
- Not restrict access or alter cover to buried services and stormwater lines particularly at fittings, connections and inspection points.
- Not create unacceptable future maintenance practices.
- Minimise disruptions to traffic due to maintenance activities.
- Not create unsound or hazardous structures.
- Vegetation and hard landscaping must not:
 - Create unsafe or nuisance surface flooding or pavement damaging subsurface flooding by irrigation systems or associated water quality measures.
 - Restrict view and sight lines which have implications for public safety and crime prevention.
 - Result in excessive implementation and maintenance costs.
 - Result in any adverse environmental or ecological impacts.

16.1.2 Landscape Design Guideline

Refer to Council's Engineering Guideline - Standard Drawings for further information on landscaping requirements.

Enquiries regarding landscape design and approval shall be directed to Council's Representative.

16.2 Street Tree Planting

Planting Street tree planting will be dependent on the individual street width, traffic speed and volume, road user safety and public utility services and will therefore require site specific designs to be employed. Council has a list of preferred species for new subdivisions and developing preferred street tree lists for existing streets.

16.2.1 Street Tree Planting Objectives

The primary objective of street tree planting is to provide a healthy tree canopy within the urban and suburban environments that is safe, robust, provides good amenity and retains biodiversity.

Landscape designs shall be fit for purpose and lead to cost effective landscaping schemes, requiring careful examination of cost estimates for implementation of landscaping works and for the ongoing maintenance of landscaped areas within road reserves.

16.2.2 Safety in Design

Safe System principles shall form part of the decision-making process when preparing landscape designs within road reserves regarding sight lines at intersections and property accesses, roadside hazards and the potential obstruction of road traffic signs.

Safety in Design principles shall also form an integral part of the landscape design process to ensure work health and safety requirements are properly considered for persons implementing landscaping proposals and for future maintenance activities.

Road clear zones (typically 3m from the traffic lane or edge line in an urban residential area) shall be kept clear of trees and shrubs greater than 100mm in diameter at a height of 500mm from the surrounding ground level. Where tree planting is proposed within the road reserve and it is impractical to achieve the required clear zone widths, a road safety barrier system shall be considered for road user safety reasons, where practicable, following a thorough risk assessment process.

16.2.3 Design Life and Location

The design life for plants selected for use in urban residential areas shall be 40 years minimum.

Desirably, street trees in urban areas should be planted so that there is no more than 1 street tree placed outside each property frontage, with an approximate spacing of 10 to 15m, where practicable, and subject to the specific location, tree species, and lot frontages.

Trees should be planted in grass surrounds within a tree pit and with a tree grate, where applicable, with a root barrier system where trees are planted near concrete kerb and/or concrete paths.

The location of street trees near underground and overhead public utility services shall require careful consideration to ensure that tree health and stability is not compromised, and public or domestic utility services are not damaged because of tree growth.

16.2.4 Permeable Pavement Systems and Root Vaulting

Street tree planting may be permitted in permeable pavement surrounds by utilising permeable block pavers and a 300 mm minimum free-draining gravel base course to reduce pavement damage and costly remedial work within the road reserve, subject to specific geotechnical engineering investigation, pavement design, and the approval of Council's Representative.

Alternative permeable pavement systems and modular structural root vault systems may also be considered where appropriate to promote healthy tree growth while protecting adjacent pavements and underground services. These systems provide a dedicated soil volume for root development beneath pavements while maintaining full structural support for the surface.

The design of any vaulting or soil-cell system shall:

- Be based on an assessment of the mature tree species' root growth area requirements.
- Demonstrate adequate structural capacity to support anticipated traffic and pedestrian loads.
- Be accompanied by a site-specific geotechnical and drainage design verifying soil moisture balance and infiltration performance.
- Allow for inspection and maintenance access.
- Be installed in accordance with the manufacturer's specifications and Council's approval.

Examples of acceptable modular vaulting systems include engineered soil-cell products such as Citygreen's Stratavault™ or equivalent systems proven to provide adequate root growth volume while preventing pavement displacement.

For residential areas a suitable root control device is expected to be constructed for each approved street tree location.

Refer also to the article "An infiltration approach to reducing pavement damage by street trees" by T. Lucke and S. Beecham (Science of the Total Environment 671, 23 March 2019) for further technical context on infiltration-based tree planting design.

16.2.5 Landscape Design Guideline Street Tree Planting

Technical details have been developed to ensure Service Providers provide appropriate and consistent treatment for street tree planting.

Refer to Hilltops Council's, Engineering Guideline - Standard Drawings for further information on street tree planting requirements.

Street tree planting design plans or landscape design plans shall be submitted to Hilltops Council for consideration and approval prior to any installation within road reserves.

For standard residential allotments with an average street boundary distance of 20m for example, a street tree is to be located mid allotment. Also refer to Engineering Guideline - Standard Drawing typical street cross section SD 0902.

For further general tree planting arrangements in subdivisions, please refer to Hilltops Councils current DCP.

16.3 State Roads

Street tree planting proposals on state roads shall be planned in consultation with the appropriate TfNSW representative and in accordance with the TfNSW Landscape Design Guideline and Biodiversity Guidelines.

16.4 Tree Preservation

Hilltops Council has various Tree Preservation Orders on trees situated within the LGA.

On private lands is noted in the current DCP. For trees other Council owned and managed lands see relevant policies and other statutory requirements.

These orders prohibit, without the express prior approval of Council, the ring-barking, cutting down, topping, lopping, removal or wilful destruction of trees, notwithstanding whether such trees are on public or private land.

Drawings for proposed development works are to show trees which may be affected together with species identification. Any approval to remove trees will be assessed in the overall development approval process. No trees are to be removed until approval is given in the approval process.

Scarred or significant trees (Heritage/Aboriginal or endangered species) must be labelled on the drawings and preserved on site.

17 Design of Water Reticulation

17.1 Introduction

This section outlines Hilltops Council's recommended practice for design of water reticulation.

The document relates to small scale water supply works for pipelines up to 225mm diameter where the water supply source for the development is taken from the existing system. Where projects involving larger diameter pipelines, or more complex infrastructure, the Suitably Qualified Person will need to consult with Council's Representative.

This document is not a comprehensive "Design Manual". It is intended to be read in conjunction with, and as a supplement to the relevant Water Supply Code of Australia.

17.2 Minimum Standards for Water Reticulation Design

This document outlines Hilltops Council's recommended practice for design of water reticulation.

It is not a comprehensive "Design Manual" and it is intended to be read in conjunction with documents referenced in Section 17.3.

The design for Water Reticulation should be made with consideration for other services. Road design guide, Sewerage Reticulation and Landscaping can be found in the sections of this document as follows.

- Part 1 Design Guideline.
- Part 2 Construction Specification.
- Part 3 Standard Drawings Parts A and B.
- Part 4 Development and Projects Construction and Inspection Guide.

17.3 References

This section of the Design Minimum Standards should be read and utilised in combination with the following publications as referenced throughout:

- Water Supply Code of Australia, WSA 03-2011 (Latest Version), Water Services Association of Australia [WSA 03-2011]
- AS/NZS 2280 Ductile Iron Pipes and Fittings
- AS/NZS 4087 Metallic Flanges for Waterwork Purposes
- AS 1432 Copper Pipes for Plumbing, Gas fitting and Drainage Applications • National Construction Code - Volume 3 Plumbing Code of Australia
- National Construction Code - Volumes 1 & 2 Building Code of Australia
- AS/NZS 2544 Grey Iron Pressure Fittings
- AS/NZS 3500 Plumbing and drainage suite
- AS/NZS 2648 Underground marking tape non-detectable tape
- AS 1100 Technical drawing Engineering survey and engineering survey design drawing.
- AS/NZS 2566 - Buried flexible pipelines (Parts 1 & 2)

- AS/NZS 2845 Water Supply – Backflow prevention devices
- AS 2419 Fire hydrants installations
- AS 2638 Gate valves for waterwork purposes
- AS 2200 Design charts for water supply and sewerage
- AS/NZS 4130 Polyethylene pipes for pressure applications
- AS/NZS 4129 Fittings for polyethylene pipes for pressure applications
- AS 2832 Cathodic protection of metals
- AS 1906 Retroreflective materials and devices for road traffic control purposes
- AS 3952 Water supply – Spring hydrant valve for waterworks purposes
- AS/NZS 3725 Design for installation of buried concrete pipes
- AS 3735 Concrete structures for retaining liquids

17.4 Classification of Mains and Areas for Water Supply

For each town and village within Hilltops Council area provided with reticulated water, Council has adopted areas that are defined as water reticulation areas. Broadly, these areas are those designated within the 50 km/h built up Town and Village zones where reticulated water is available. These areas are those where:

- Treated water shall be supplied at full mains pressure (static head ranging from 20m to 80m).
- Firefighting is to be supplied via the reticulation through the provision of hydrants.

Outside of those areas if treated water is to be supplied by Council, those areas will be classified as Trickle Flow Areas.

Broadly for these Trickle flow areas:

- Treated water shall be supplied at a maximum flow rate to each connection of 0.06 l/sec to feed into the onsite tank.

For Backflow protection the following devices are required:

- Tank Air gap - 300 mm or greater
- RPZD at all connection points on the customer side of the meter to be installed, tested and reported in accordance with Council's Backflow Prevention Policy.
- Firefighting shall be provided by on site storage at each property and not the reticulation.
- Property owners are to install an on-site tank (20,000 litre min. capacity) designed to allow firefighters to tap in and their own pressure pump system for domestic water supply.

Trunk and Distribution mains are those pipelines which transfer water to reservoirs, link reservoirs or areas of demand, or distribute water to or through areas of development. These pipelines are of strategic importance to the operation of the reticulation system irrespective of size. Individual service connections will not be permitted to Trunk Mains.

Table 34 below shows the various reticulation systems and related system classification in terms of either council reservoir sourced – “Reticulated” or pressure/flow from external source – “Trickle”.

Table 34: Area and Reticulation Classification

Area/Reticulation System	Classification
Boorowa Township	Reticulated
Harden Murrumburrah	Reticulated
Young Township	Reticulated
Jugiong Village	Reticulated
Galong Village	Reticulated
Wombat Village	Trickle
Prunevale rising and reticulation	Trickle
Aurville area (north of Harden)	Trickle
Demondrille Area off Harden rising main from GWCC	Trickle
Galong rising main and Galong South scheme	Trickle
Harden rising main	Trickle
Kingsvale and Wombat rising main	Trickle
Jugiong rising mains	Trickle
Wallendbeen rising main	Trickle
Jugiong to Young Golden Fields Water County Council rising and back fed supply mains e.g. Kingsvale.	Trickle

17.5 General Requirements Regardless of Area

17.5.1 Design

Any development application that involves changes or extension to Council's existing water infrastructure, or construction of new water infrastructure, must be accompanied by documentation that complies with the requirements detailed in the following sections including plans and calculations at the time of submission.

The Checklist – Water Supply Design in **Error! Reference source not found.** and **Error! Reference source not found.** shall be completed and submitted with the Drawings. Should any of the items included in the checklist be outstanding or not to a standard acceptable to Council, the Drawings shall be returned to the developer for amendment. Council shall only commence review of the design drawings once it is satisfied that all the requirements of the checklist have been met and the Subdivision Works Certificate fee has been paid.

17.5.2 Servicing Strategy

All design elements submitted must comply with the Servicing Strategy approved by Council as part of the conditions of development consent issued for the subject development, as appropriate.

For residential subdivisions over 25 lots, the Developer is required to complete an appropriate design hydraulic modelling study that will be submitted to the Council's Representative for approval. The study will need to indicate the impact of the development on the water supply system generally and the immediate area adjacent the development. The area of hydraulic modelling may need to be extended upstream or downstream depending on the area of concern. The study outcomes will be reviewed by Council's Representative prior to the submission of drawings and associated documentation.

Changes to the approved Servicing Strategy must be approved by Council's Representative prior to the submission of plans and associated documentation.

For development applications which will require the existing upstream infrastructure to be upgraded, to meet the expected servicing demands of the development in accordance with the relevant reference documents, the developer will cover the cost of the upgrade.

17.5.3 Future Demands

Water supply components are to be sized to cater for proposed future development. Council's current reticulation analyses will be used as a guide in assessing size requirements.

In certain cases where Developers are requested by Council to construct infrastructure that caters for future demand as well as their own development, Council may consider to reimburse the difference in cost between constructing the larger components and the size required to supply the development. Council shall calculate the difference in this cost using the latest version of NSW Reference Rates Manual for Water and Sewerage Construction' issued by NSW DCCEW.

17.5.4 Plans and Calculations

The Checklist – Water Reticulation Design in Appendix A: shall be completed and submitted with the Drawings. Should any of the items included in the checklist be outstanding or not to a standard acceptable to Council, the Drawings shall be returned to the developer for amendment. Council shall only commence review of the design drawings once appropriate certificate fees are paid, and it is satisfied that all the requirements of the checklist have been met.

This will be considered on a case-by-case basis and a formal request is to be made to initiate any Council consideration.

Design drawings and calculations shall be submitted to Council for approval. Information to be included in the design drawings is detailed in Appendix B: – Information to be shown on Water Reticulation Drawings. The completed checklist shall be submitted with the Drawings.

The general proposal for the water reticulation is to be submitted as part of the Development Application. Detailed design and documentation are required to be submitted and approved by Council prior to the issue of the Construction Certificate/Subdivision Works Certificate.

17.5.5 Structures

Detailed engineering drawings are required for any structures such as reservoirs, pumping stations and valve pits proposed for construction in conjunction with water supply works. Also included but not limited are thrust block designs for elbows and stop valves.

17.5.6 Locations and Cover

Water mains are to be located on the footway in accordance with the footway allocations referred to in Part 1 of these Design Minimum Standards and shall extend to the extremity of the development.

Cover to pipelines will be in accordance with the manufacturer's specifications; however minimum cover required in footways and driveways, and under road carriageways shall be in accordance with Hilltops Councils Standard Drawings Volume B W series. The depths may need to be increased on larger diameter mains to accommodate larger fittings in accordance with Hilltops Councils Standard Drawings Volume B W series. Where located in classified road carriageways or railway corridors, cover shall be as approved by the respective Roads Authority or Rail Authority.

The Council Representative may give approval for infrastructure to be located in areas other than road reserves provided an easement is created. The developer should transfer to Council any water easements provided in the subdivision and execute a transfer and grant of easement in favour of Council pursuant to Section 88B of the Conveyancing Act 1919, as amended. The minimum width of water easements shall be 3.0m for reticulation mains and 5.0m for trunk mains.

The Council Representative may require water mains to be located on both sides of the road in commercial/industrial areas, in areas likely to have high or medium density housing, at the boundaries between pressure zones and on highly trafficked roads.

Water mains are to be provided for the full extent of the development to facilitate the systematic and orderly expansion of Council's infrastructure

17.5.7 Mains in Cul-de-Sacs

Where the cul-de-sac incorporates a pathway to an adjacent street or ends in a park, the water main is to extend through the pathway or park so that a dead-end is not created in the main. Where a pathway or park is not provided, the main is to be returned at the end of the cul-de-sac to form a loop main which should conform to the following criteria:

1. The loop is to be totally on the footway, apart from the one road crossing required to reconnect with the main
2. The loop is to incorporate a minimum of 3 separate service tapping's, each separated by at least one block frontage
3. A hydrant is to be provided within the loop approximately equidistant from loop back point; and
4. The loop is to cross the road perpendicular and at the start of the neck at the Cul-de-sac.
5. Changes in direction of the main shall be achieved through the installation of deflection fittings supported by appropriately designed thrust blocks and by deflections at pipe collars within the manufacturer's tolerance guidelines.

17.5.8 Hydrant, Flushing Point and Stop Valve Chambers

Around each valve, hydrant and flushing point, a chamber of the type shown in the Hilltops Council Standard Drawings Volume B for Water Series - Fittings will be provided.

Unless otherwise specified, each valve chamber should be covered by a cast iron surface box cast into a concrete block as shown on the Standard Drawings for Water SD1100 Series - Fittings however other covers will be considered.

Typical Valve & Hydrant Installation Drawings:

- SD 1104: Valve Arrangement
- SD 1104: Hydrants & Air Relief Valves
- SD 1104: Hydrant Surface Boxes, Trafficable & Non-trafficable
- SD 1104: Hydrant Surface Boxes, Trafficable

Typical Surface Fitting Installation Drawings:

- SD 1104: Gate Valve Surface Boxes, Non-trafficable
- SD 1104: Gate Valve Surface Boxes, Trafficable

Concrete surface box covers and surrounds shall be used in roadways suitable rated for highway use.

17.5.9 Existing Stop Valves and Hydrants

Where the subdivision is utilising existing water mains, the level of hydrant and stop valve surface boxes should be adjusted to suit new surface levels.

17.5.10 Detector Tape

A metal detectable tape complying with Australian Standard AS/NZS 2648 and green in colour shall be laid with water mains constructed from material other than Ductile Iron Cement Lined in accordance with the manufacturer's specifications. At a minimum such tape shall be continuous and electrically bonded to metallic components including services and standpipes.

OR

A non-Detectable Marking Tape (WSAA Product Specification WSA PS-319, Marking Tape, Non-Detectable) in conjunction with a Copperhead Reinforced Tracer Wire System (WSAA Product Specification WSA PS-343, Tracer Wire) shall be laid with water mains constructed from material other than Ductile Iron Cement Lined, in accordance with the manufacturer's specifications.

17.5.11 Tapping Bands

Approved tapping bands are to be used for all service connections. Tapping bands including hard stop design will be required when using non DICL pipe material. Thin brass type tapping bands will not be permitted. Readytap, multi-tap and wang connectors or equivalent are acceptable.

17.5.12 Water Meter Installation

Council requires that all lots, including areas set aside for recreation, be provided with a water meter in a location as detailed in the Hilltops Council Engineering Guidelines – Part 3 Standard Drawings for Water series – SD 1102. The Developer to pay applicable fees and

lodge developer water meter payment form prior to the subdivision release where water supply is required directly for subdivision related works like sewer pump stations.

Water service tapings shall not be located within the carriageway or under the kerb.

Council will supply and install water meters once the applicable fees and charges have been paid and upon registration of the subdivision and following receipt of a request for water meter connection from the property owner.

The Developer will pay applicable fees and lodge developer water meter payment form prior to subdivision release. Council will supply and install water meters once the applicable fees and charges have been paid and upon registration of the subdivision following receipt of a request for water meter connection from the property owner.

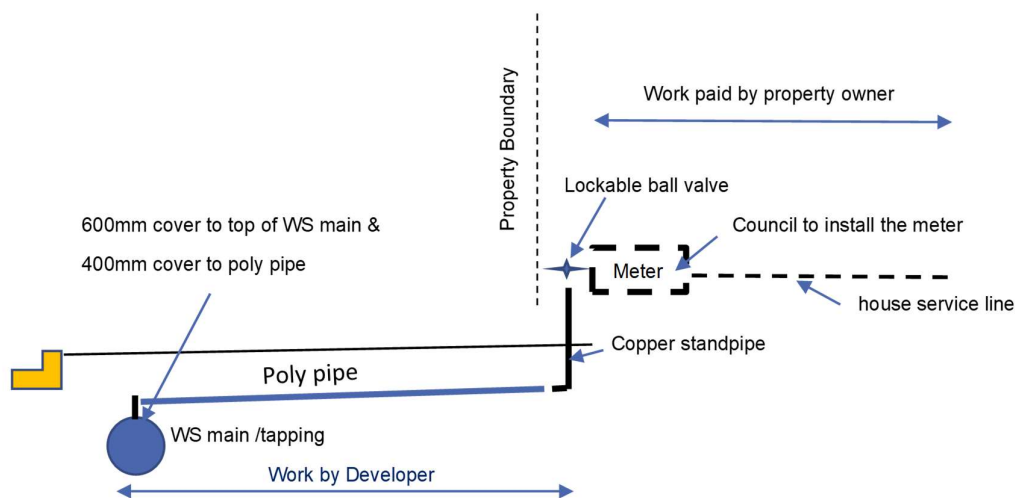


Figure 6: Water Meter Installation

17.5.13 Shared Trenching

17.5.13.1 Footways

Shared trenching will not be permitted.

17.5.13.2 Road Crossing

All road crossings are to be provided at right angles to the road centreline at the point of crossing.

Shared trenches will be permitted between utilities provided the minimum separation between utilities, not in conduits, is 300mm both in the horizontal or vertical direction.

Shared trenches will be permitted between utilities provided the minimum separation between the outside of the conduits containing the utilities is 150mm in the horizontal or vertical direction.

Fill between the conduits shall be as detailed in the Hilltops Council Standard Drawings for Water Series - Trench/ Embedment.

17.5.14 Pipe/Fitting Connection

Connection of pipes will be in accordance with the manufacturer's instructions.

Typical Mains Construction Drawings:

- SD 1101: Reticulation Main Arrangements Sheet 1.
- SD 1101: Cul-De-Sac Arrangement Sheet 2.
- SD 1101: Connection to Existing Mains Sheet 3.

Property Services Drawings:

- SD 1102: Connection to Main Sheets 1 - 6

In the case of Polyethylene all pipes and fittings are to be joined by electro fusion techniques in accordance with the manufacturer's requirements. Those carrying out the pipe joins are to be appropriately qualified, capable of demonstrating their experience with this technique and have the right equipment to affect the welds. Council will also consider butt welding of the pipes by persons with the appropriate qualifications, equipment and experience.

Service connections will be via brass or stainless-steel tapping bands with one mechanical connection allowed to allow connection of the service to the copper standpipe.

Connection of pipes will be in accordance with the manufacturer's instructions.

17.5.15 Pressure Reducing Valves

Where Pressure Reducing Valves (PRV's) are required they shall be of a type and design approved by the Director.

Pits to house PRV's will be constructed from concrete, or other suitable material, and be of a size that allows a clear work area of at least 600 mm in all directions around the PRV. A drain shall be located in the bottom of the pit which drains to adjacent water course or drainage structure. Dismantling joints will be provided on the upstream and downstream side of the valve and the pit will have lockable removable covers.

- SD 1104: Fittings – DN100 Pressure Reducing Valves (PRV)

17.5.16 Opening of Valves

The developer is required to establish that all valves and service connections are fully open, following construction as appropriate.

IMPORTANT NOTE: Design drawings shall indicate Stop valves and scour valves closing orientation are to be for the following reticulation areas:

- Young – Anticlockwise closing (ACC)
- Boorowa – Anticlockwise closing (ACC)
- Harden – Clockwise closing (CC)

All valves to be resilient sealed and have a minimum pressure rating of Class 16.

17.5.17 Thrust Blocks

Valves, flexible jointed bends, tees, dead ends, and other points in the pipeline where there are unbalanced forces should be adequately restrained to withstand the forces resulting from the internal pressure when the pipeline is in use by packing between the fitting and the side

of the trench with concrete as detailed in the Hilltops Council Standard Drawings for Water Series - Trench/ Embedment.

Stop valves on mains of 150mm diameter or greater are to be fixed to a thrust block.

The Developer shall be responsible for any failure of the pipeline that may be due to inadequate restraint in accordance with the Hilltops Council Standard Drawings for Water - Trench/ Embedment.

- SD 1103: Trench embedment, Thrust and anchorage blocks for Gate Valves & Vertical Bends, Restrained Joint Systems. Sheets 1-7.

17.6 Water Reticulation Areas

17.6.1 Minimum Requirements

Council requires that all allotments, including areas set aside for recreation and sewer pump stations, be provided with a reticulated water supply sufficient for both domestic and firefighting purposes.

17.6.2 Water Demand

The design water demands should be calculated in accordance with WSA 03-2011 (Latest version).

17.6.3 System Components

The water supply system components should be designed generally in accordance with WSA 03- 2011 and Council requirements as detailed in these Minimum Standards.

Demand rates vary across geographical locations. Values used for hydraulic design should take account of:

1. The Council's long-term consumption records for similar development types (e.g. residential, commercial, industrial) in the region.
2. Alternative supply measures in the development e.g. rainwater tanks, recycled water.
3. Variation of demand over a 24-hour period (diurnal variation). Where there are measures in the supply system development (e.g. adoption of alternative water sources for non-drinking water uses) that would reduce demand rates, the specific advice of the Council shall be sought to determine the appropriate demand rates to be adopted for its water supply system.

17.6.4 Service Reservoirs

Minimum capacity is one day's supply at future peak day demand with a minimum design life of 50 years.

17.6.5 Static Head

Recommended minimum static head required at the meter location for each lot, when the service reservoir is one third depleted, refer to Part 2 Table A. Table 35 states maximum and minimum static head requirements for the various reticulation areas.

Table 35: Recommended Minimum Static Head Requirements

Location	Recommended Minimum Static Head (Metres)	Recommended Maximum Static Head (Metres)
Boorowa	20	80
Galong	20	80
Harden/Murrumburrah	20	80
Jugiong	20	80
Wallendbeen line	20	80
Wombat	20	80
Young	20	80

The main is to be capable of delivering peak instantaneous demand to each lot, while maintaining a minimum head of 12m throughout the system with the service reservoir assumed to be two thirds depleted.

17.6.6 Pipe Size

The watermain pipe sizes are to be determined to ensure adequate turnover of water to reduce retention time and to ensure adequate flow rate and pressure is achieved at the most disadvantaged location during peak hour demand. Table 36 may be used to establish reticulation main pipe sizes.

Table 36: Empirical Guide for Pipe Sizing Extracted from WSA 03-2011.3.1

Nominal Size of Mains DN			Capacity of Main (single direction feed only)			
Cast iron outside diameter	ISO series	Max Flow Rate (L/s)	Residential (lots)	Rural Residential (ha)	General/ Light Industrial	High Usage Industrial (ha)
100	125	4	40	10	N/A	N/A
150	180	12	160	125	23	N/A
200	250	20	400	290	52	10
225	280	28	550	370	66	18
250	315	38	650	470	84	24

The minimum acceptable pipe size shall be DN100 in residential areas and DN150 in commercial and industrial areas.

Mains with permanent dead ends are to be avoided wherever practicable by providing link or looped mains to ensure water circulation.

Where a dead-end main cannot be avoided, DN100 mains shall only be permitted where lot frontages (service connection spacing) are less than 24m.

DN100 mains exceeding 2,000m in length are not permitted.

In cul-de-sac or terminus areas where looping is impractical, a reduced main size (minimum DN63) may be considered, limited to a maximum length of 50m and serving no more than five DN20 property connections.

17.6.7 Mains and Fittings

17.6.7.1 Materials

All mains must be constructed from material which is compatible with Ductile Iron fittings. Council may direct that any water mains should be constructed from PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with AS/NZS 2280.

This will usually only apply to those designated as trunk or distribution mains which service adjacent development. All cast or ductile iron fittings shall be cement or epoxy lined and conform to AS/NZS 2280.

Stop valves and scour valves are to be in accordance with 17.5.16 and resilient seated, with stop valves to have a minimum pressure rating of PN16.

For flanged pipe the pipe barrel is to be manufactured to AS/NZS 2280 flanged class. Flanged fittings should be cement or epoxy lined and conform to AS/NZS 4087 and AS/NZS 2280 with a minimum pressure rating of PN16 or PN35 depending on the application.

All water mains crossing the carriageway/roadway shall be constructed of Ductile Iron Cement Lined pipe from fitting to fitting.

Where it is proposed to use pipe material other than PN35 Ductile Iron the Developer will be required to show that the material proposed conforms as follows:

- Pipe is suitable to meet pressure requirements at the proposed location.
- Where PVC pipe is proposed, only PVC-O will be considered.
- Has the minimum required pressure rating of PN16.
- Is compatible with Ductile Iron fittings.
- Fatigue and/or cyclical load testing indicates the material will meet a minimum 100-year design life.
- Will not be adversely affected, in terms of shape and strength by construction loading.
- Installation method to manufacturers instruction for minimum 100-year design life; and
- Complies with all relevant Australian Standards.

17.6.7.2 Hydrants and Valves

Fire hydrants shall be provided along each water main at a maximum spacing of 90 metres in residential areas and 160 metres in rural residential areas. Additional hydrants shall be installed at the end of all dead-end mains, at road intersections or significant changes in direction, and at high and low points where required for maintenance and flushing.

Hydrant design and placement shall comply with WSA 03–2011 (Version 3.1) and the Fire and Rescue NSW “Guidelines for Minor Residential Developments – Fire Hydrant Requirements” (2022). In accordance with the FRNSW Guidelines, hydrants shall be positioned so that a hydrant is available within 70 metres of the most distant part of any dwelling, measured along the route accessible to firefighting appliances.

An air valve shall be provided at every high point on the main, complete with an air isolation valve to allow maintenance without shutting down the main. A hydrant or scour valve shall be provided at all low points. Scour discharges shall connect to an approved stormwater pit or, where unavailable, to an approved adjacent watercourse or stormwater facility. Stop valves shall be installed at all pipeline intersections and branches so that each section of main can be isolated by closing a maximum of three (3) valves. A stop valve shall also be provided adjacent to each hydrant, located on the downstream side (away from the water source) to enable local isolation for maintenance.

Where kerb and gutter exist, the locations of hydrants and stop valves shall be identified by formed kerb impressions, with lettering in accordance with 17.6.7.3 and Standard Drawing SD 1104. Where no kerb and gutter are provided, galvanised steel marker posts and indicator plates shall be installed on the footway at the property line, perpendicular to the fitting location, as detailed in HC Standard Drawings Volume B SD 1104 Series – Fittings. Reflective blue raised pavement markers (RPMs) shall be noted on the drawings for fixing to the centreline of the road, perpendicular to each hydrant location.

All maincocks, hydrants, stop valves, scour valves and air valves shall be located within the footway unless otherwise approved. Hydrants and valves are not to be located within table drains. Hydrant and valve covers shall open in the direction of the main.

17.6.7.3 Kerb Impressions

Lettering for respective infrastructure to be as follows.

- SV – Stop valves,
- SCV – Scour valves
- H – Hydrants
- W – Water mains, water service
- AV – Air Valves

In addition, the following kerb impressions should also be made to indicate the location of relative infrastructure.

- S – Sewer main
- SRM – Sewer Rising Main
- G – Gas
- T – Telecommunications
- E – Electrical

Kerb Impressions are to be installed as per the Hilltops Engineering Guidelines Part 3 Standard Drawings SD 1104 Series - Fittings

17.6.7.4 Trench Drainage Bulkheads and Trench Stops

Trench Stops or concrete bulkheads are required for water main grades of 10 % or steeper in accordance with Hilltops Engineering Guidelines Part 3 Standard Drawings SD 1103 Series - Trench/Embedment Spacing requirements are detailed in Table 37.

Table 37: Trench Stops Spacing

Type	Grade (%)	Horizontal Spacing (m)
Trench Stop	10	10x Depth to Invert
	15	6x Depth to Invert
	20	5x Depth to Invert
	25	4x Depth to Invert
	33	3x Depth to Invert
	50	2x Depth to Invert
Concrete Bulkhead for all water mains at grades of 15% or greater		

Adequate trench drainage is required to prevent trench scouring and subsidence due to high permeability of the bedding and trench fill.

17.6.8 Service Connections

17.6.8.1 Materials

Water services should be of single service Type A drawn copper pipe, manufactured in accordance with AS 1432 or Polyethylene (PE) in accordance with AS 4130.

Services are to be a minimum of 20mm nominal diameter copper with minimum 1.4mm wall thickness, or 32mm OD PN16 Polyethylene (i.e. equivalent nominal internal diameter of 25mm) in accordance with HC Standard Drawing SD1100 Series.

Fittings at joints, branches and bends shall be brass or copper capillary fittings, or another type specifically approved by the Director. Ball valves and elbows shall be manufactured from brass and shall also be of a type approved by the Director. Any proposed variation to the materials or fitting types specified above must receive prior approval from the Director.

17.6.8.2 Location

Water services are to be laid at right angles to the road centreline and parallel to the radius on curves and in cul-de-sac ends.

The services are to have a minimum cover in accordance with Hilltops Engineering Guidelines Part 3 Standard Drawings SD 1102 Series – Service Details.

The service is to terminate inside each lot in accordance with Hilltops Engineering Guidelines Part 3 Standard Drawings SD 1102 Series – Service Details.

The minimum distance between two (2) adjacent tapping bands is 600mm for uPVC and PE mains unless specified differently by the pipe manufacturer. Tapping into pipes pulled on/for curves/bends should be discouraged.

All maincocks are to be located in the footway/verge area.

In Industrial/Commercial areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe shall be 100mm. PN 9, uPVC pipe is required as a conduit.

In residential areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe for copper services shall be 50mm. PN9, uPVC pipe is required as a conduit.

Conduits may be laid for future proposed services; however, the service is not to be connected to the water main.

Fire service to be contained within lot served.

17.6.8.3 Nominal Size of Water Service

The minimum size of a water service in both residential and industrial / commercial areas is 25 mm ID with a 20mm service to be provided for residential service and 25mm service to provide for industrial / commercial areas in accordance with HC Standard Drawings.

For areas set aside for recreation, a 32mm service with a 20mm meter is to be provided.

However, firefighting requirements and other considerations may warrant a larger service size. The Developer is responsible for nominating the correct size water service.

The size of service required shall be determined in accordance with the National Construction Code – Volume 3 Plumbing Code of Australia and AS/NZS 3500 to ensure adequate flow and pressure is provided to each property.

The size of water services serving multiple dwellings, flats or units will vary as detailed in Table 38.

Table 38: Minimum Size of Water Service

Class of Building	No. of dwellings	Service Size (mm)	Maximum Length (m)
Class 1 Single Dwelling House	1	25	130
Class 1&2 Excluding Single Dwelling House	1	25	100
	2	25	100
	3-5	32	100
	6-10	40	100
	11-16	50	100

Notes: Classes are defined in the National Construction Code of Australia Volume One Limitations of Method:

1. *Total length as measured from the water main to the last branch offtake is not to exceed the total length as stated above.*
2. *Height of the highest fixture above the water main is not to exceed 4m, where the minimum mains pressure is 15m (150 Kpa).*

17.6.8.4 Fire Services

1. Where a development comprises of a multi-dwelling complex, the Council watermain shall be constructed conformant with Fire and Rescue NSW guidelines.
2. Where there is a non-residential development, the developer shall provide Council with a design for the internal fire services that is compliant with the relevant Australian Standards and regulations.
3. Fire services should not be designed to allow direct pumping out of the council main unless the developer demonstrates that on-site storages tanks are a non-viable option for the fire service.

17.7 Low Flow (Trickle Feed) Water Supply Areas

17.7.1 Minimum Requirements

Council requires that all proposed rural residential allotments be provided with a reticulated water supply sufficient for domestic supply and in accordance with the appropriate water demand and shall be in accordance with Hilltops Council's Policy "Low Flow (Trickle Feed) Water Supply".

17.7.2 Water Demand

The design water demands are to be calculated in accordance with WSA 03-2011 except that the demand for each residential allotment is a maximum of 0.06 Litres/sec Flow reduction devices shall be fitted to each service to limit flow to 0.06 Litres/sec.

17.7.3 System Components

The water supply system components should be designed in accordance with WSA 03-2011 and Council's requirements as stated in these Minimum Standards.

17.7.4 Service Reservoirs

Minimum capacity is one day's supply at future peak day demand and minimum design life of 50 years.

17.7.5 Pressure Head

The main is to be capable of delivering 0.06 Litre/sec demand to each lot, while maintaining a positive pressure head throughout the system with the service reservoir assumed to be two thirds depleted.

17.7.6 Pipe Size

Mains are to be sized to meet the required demand of this and/or proposed future developments.

Future Demands Minimum nominal internal diameter of all pipes shall be 100 mm Council's current reticulation analyses will be used as a guide in assessing size requirements.

17.7.7 Pipelines in Trickle Flow Areas

17.7.7.1 Mains and Fittings – Materials

All mains of diameter 100mm or greater must be constructed from material which is compatible with Ductile Iron fittings.

Council may direct that water mains shall be constructed from PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with AS/NZS 2280. This will usually only apply to those designated as distribution mains which service adjacent development.

All cast or ductile iron fittings should be cement or epoxy lined and conform to AS/NZS 2544 and AS/NZS 2280 respectively.

Where it is proposed to use pipe material other than Ductile Iron the Developer will be required to show that the material proposed conforms as follows:

- Is compatible with Ductile Iron fittings.
- Fatigue and/or cyclical load testing indicates the material will meet a 100-year design life.
- Will not be adversely affected, in terms of shape and strength by construction loading; and
- Complies with all relevant Australian Standards.

17.7.7.2 Flushing Points, Hydrants and Valves

Flushing points are to be provided at dead-ends. Air valves, complete with isolation valves, are to be provided at all high points in the main.

A hydrant or air valve is to be provided at all high points and a hydrant or scour valve at all low points.

Air valves are to be installed with an air isolation valve to allow maintenance of the air valve without shutting down the main.

Scour valves are to be discharged to an approved adjacent water course or approved drainage structure.

Stop valves are required at all pipeline intersections and branches so that each section of line can be isolated separately, by closing a maximum of three (3) valves.

Stop valves and flushing points should be delineated by the installation of galvanized steel marker posts and indicator plates erected on the footway, at the property line, perpendicular to the location of the valve or hydrant. The Hilltops Engineering Guidelines Part 3 Standard Drawings SD 1104 Water Series - Fittings provides details regarding posts and indicators.

All main cocks, flushing points, stop valves, scour valves and air valves are to be located on the footway, unless approved otherwise.

17.7.7.3 Service Connections – Materials

From 1 May 2026, all new installations including service lines must use lead free, Watermark-certified materials.

Water services should be of single service Type A drawn copper pipe, manufactured in accordance with AS 1432.

Services are to be a minimum of 20mm nominal diameter with 1.4mm wall thickness.

Fittings at joints, branches and bends are to be brass or copper capillary fittings. Ball valves and elbows are to be of brass and of a type approved by the Director.

Any proposed amendments to the materials above shall be as approved by the Director.

17.7.7.4 Service Connections – Locations

Water services are to be laid at right angles to the road centreline and parallel to the radius on curves and in cul-de-sac ends.

The services are to have a minimum cover of 500mm under carriageways and 300mm in footway reserves.

The service is to terminate inside each lot in accordance with the HC Standard Drawings for Water 1102 Series - Service Details. The minimum distance between two (2) adjacent tapping bands is 600mm.

All main cocks are to be in the footway.

In residential areas services under carriageways should be laid in approved conduit pipes. The minimum conduit pipe for copper services shall be 50mm. PN 9, uPVC pipe is required as a conduit.

17.8 Drawings - Water Reticulation System

Details	Drawing Series Reference
Water Mains typical arrangements and connections details.	SD 1101 series
Service line details DN 50 or less, plus fire service.	SD 1102 series
Trench/Embedment – thrust block and anchorage details.	SD 1103 series
Fittings (Valves, Fittings and surface fittings/details).	SD 1104 series

18 Design of Sewer Reticulation Minimum Standards

18.1 Introduction

This document outlines Hilltops Council's recommended practice for design of sewerage reticulation. It is in no way a comprehensive "Design Manual" and it is intended to be read in conjunction with and as a supplement to, relevant government department publications.

The document relates to small scale sewer works for pipes up to 300mm in diameter and small pump stations.

For developments involving larger pipes or more complex infrastructure, the designer will need to consult with Council's Representative.

Where there is an inconsistency between the text and the drawings the text will prevail.

The other parts of the Engineering Guidelines for Subdivisions and Developments are as follows:

- Part 1 Design Guideline
- Part 2 Construction Specification
- Part 3 Standard Drawings Parts A and B
- Part 4 Development and Projects construction and Inspection Guide

18.2 References

This section of the Minimum Sewer Design Standards should be read and utilised in combination with the following publications as referenced throughout.

- Gravity Sewerage Code of Australia, WSA 02-2014, Version 3.1, Water Services Association of Australia [WSA 02-2014]
- Sewage Pumping Station Code of Australia, WSA 04-2005, Version 2.1, Water Services Association of Australia [WSA 04-2005]
- Pressure Sewerage Code of Australia, WSA 07-2007, Version 1.1, Water Services Association of Australia [WSA 07-2007]
- National Construction Code - Volume 3 Plumbing Code of Australia
- National Construction Code - Volumes 1 & 2 Building Code of Australia
- AS/NZS 3500 Plumbing and drainage suite
- AS/NZS 2648 Underground marking tape non-detectable tape
- AS 1100 Technical drawing Engineering survey and engineering survey design drawing
- AS/NZS 1260 uPVC SN8
- AS/NZS 5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
- AS/NZS 3000 – Electrical Installations – Wiring Rules

18.3 Gravity, Pump Out or Low Pressure

The DCP and Government policy directives establish the requirements for developments to be sewered rather than utilising on-site sewerage systems. The reason for installing a sewerage system is for the protection of public health, the environment, and public amenity.

Council's preferred method of providing sewerage services to individual properties is via gravity sewer connected into Council's existing reticulation.

Individual connections in both residential and industrial/commercial areas that cannot be connected to the existing reticulation via gravity can be connected to the existing reticulation via either:

1. Gravity sewer to a dedicated pump station and rising main to Council's system or
2. By a series of private pressure pump pods/low pressure sewer rising main system.
Certain conditions apply as detailed in these Minimum Standards.

This is only after it has been demonstrated that the provision of gravity sewer is not possible. Certain conditions including responsibility for various components of the system may apply.

The design and installation shall comply with Council's policy for Pressure Sewer Systems. Reference also Section 18.7 Pressure Sewer Systems.

18.4 General Requirements

The design of sewers is controlled by the application of design and construction minimum standards as detailed below.

The minimum standards apply to the design of sewer in industrial or residential areas including medium density development.

18.4.1 Design

Any development application that involves changes to, or extension of, or conditioned in the development consent, that impacts Council's existing infrastructure, or the construction of new sewer infrastructure, must be accompanied by documentation that complies with the requirements detailed in the following sections including plans and calculations at the time of submission.

As a condition in the Development Consent for issue of the Subdivision Works Certificate, Council will require detailed documentation that complies with the requirements outlined in the following sections of the Guidelines, to be lodged and approved by Council prior to the issue of a Subdivision Works Certificate.

18.4.2 Servicing Strategy

All design elements submitted must comply with the Servicing Strategy approved by Council as part of the conditions of development consent issued for the subject development, as appropriate.

Changes to the approved Servicing Strategy must be approved by the Director prior to the submission of plans and associated documentation.

18.4.3 Future Loading

Reticulation components are to be sized to cater for proposed future development.

In certain cases where Developers are requested by Council to construct infrastructure that caters for future loading as well as their own development, Council may reimburse the

difference in cost between constructing the larger components and the size required to service the development. This will be considered on a case-by-case basis and a formal request is to be made to initiate any Council consideration.

18.4.4 Plans and Calculations

The Checklist – Sewer Design in Appendix E and Appendix F shall be completed and submitted with the Drawings. Should any of the items included in the checklist be outstanding or not to a standard acceptable to Council, the Drawings shall be returned to the developer for amendment. Council shall only commence review of the design drawings once it is satisfied that all the requirements of the checklist have been met and the Subdivision Works Certificate fee has been paid.

18.4.5 Excavating or Building Adjacent to or Over Existing Sewer Mains

Council has adopted a policy entitled Building Near Underground Assets Policy which provides details of circumstances when building, filling or excavating adjacent to or over existing sewers will or will not be approved and the minimum requirements if work is approved. The policy can be viewed on Council's website in the Council policies & Plans section at www.hilltops.nsw.gov.au.

18.5 Gravity Sewer

18.5.1 Locations and Cover

Sewers should be located wherever possible as follows:

1. In public road reserves within the footway allocation as detailed in the General Requirements Section of these Minimum Standards.
2. Sewers shall be located wherever possible in the road reserve and not in private property. The sewer shall be generally located adjacent to and parallel to a property boundary with a minimum offset of 1.2m. Sewers in road reserves shall cross the road as close as practicable to 90° to the road centreline alignment.

Where sewer mains are located adjacent to storm water drainage (SWD) lines, the sewer should be laid with a minimum 0.5m separation between the outside of the sewer and the outside of the stormwater pipe in the horizontal direction.

Generally, where the sewer and SWD are adjacent and on the same side of the boundary, the SWD should be at 1m offset from the boundary and the sewer should be at 2.0m from the boundary. The easement should be a minimum of 3m wide to accommodate the two services and the access structures

Sewer mains shall extend to the extremity of the development where potential exists for future developments.

Minimum cover required to mains and junctions is in accordance with Hilltops Council Engineering Guidelines - Standard Drawings Sewer SD1200 series.

Reference Drawings:

- SD 1201 Series - Rising mains
- SD 1202 Series - Property connections
- SD 1203 Series - Trench/ Embedment
- SD 1204 Series - Maintenance Holes (Manholes)

- SD 1205 Series - Pressure sewer
- SD 1206 Series - Ventilation

Where sewers of different diameters intersect or join, pipe obverts are to match.

Where located in classified road carriageways or railway corridors, cover shall be as approved by the respective Roads Authority or Rail Authority.

18.5.2 Materials

Reticulation pipelines and fittings may be of any of the following materials manufactured in accordance with the relevant Standards:

- uPVC SN8, - AS/NZS 1260
- Twin – walled corrugated Polypropylene – AS/NZS 5065
- All pipes other than HDPE shall be rubber ring jointed with rings complying to AS1646.

18.5.3 Property Connection

Property connection sewer shall provide a point of connection for each customer sanitary drain via adoption of Buried Interface Method. The property connection sewers must be constructed with sufficient horizontal straight pipes so that the property connection fitting is wholly within the lot to provide a point of connection for the customer sanitary drain.

- Property connection sewers shall be designed to be perpendicular to the direction of the sewer main.
- Property connection sewers shall have a minimum grade of 1.0%.
- Property connection sewers shall be a maximum length of 20m. This is the distance from the sewer main to the boundary of the lot to be serviced. Where the length exceeds 20m, this is considered a sideline, and a maintenance hole/manhole will be required to connect to the main.
- Lots shall not be connected to sewers >DN 450
- The design shall provide one property connection point per single occupancy lot
- The soffit requirement of 1.2 m shall be applied to all sewered lots.
- Connection level shall be calculated for each sewer lot using the below equation.

$$\text{Connection Level (AHD)} = \text{CSL} - (L_{sd} \times S_{sd}/100) - c - \text{DN}_{sd} - (a) - (w) - 0.5\text{DN}_{rs}$$

CSL controlling surface level in metres at 'worst case' plumbing fixture of buildings (existing or proposed)

L_{sd} length in metres from that fixture to the connection, measured along a property boundary perimeter

S_{sd} minimum permissible cover in metres of the customer sanitary drain from AS/NZS 3500.2-for protection against mechanical damage and deformation due to vehicle loadings

DN_{sd} nominal diameter of the customer sanitary drain, in m (generally 0.1)

a allowance for clearing other services

w allowance for head loss in water seal, 0.15 m, if applicable

DN_{rs} Nominal diameter of the reticulation sewer, in m

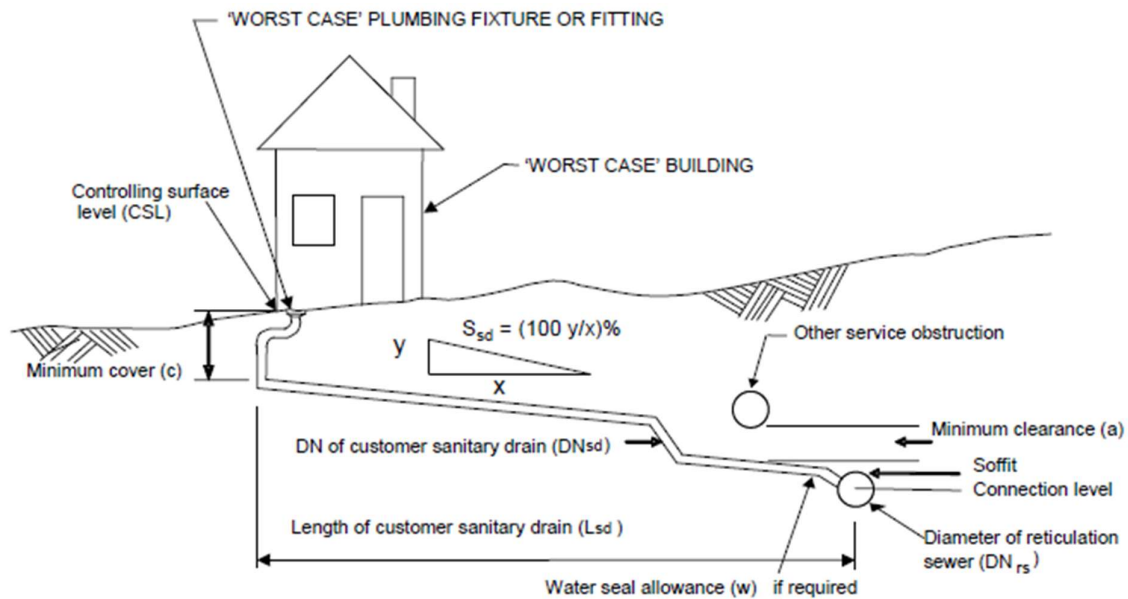


Figure 7 Physical losses in customer sanitary drains

18.5.4 Junctions

The maximum depth of the connection point shall not exceed 2.0m. Where the point of connection is $\geq 2.0\text{m}$, the connection shall be at a maintenance structure. Where lot control warrants the sewer main to be deeper than 2.0m, the property connection point shall be lowered to the calculated level for the required drainage and compliance with soffit requirements.

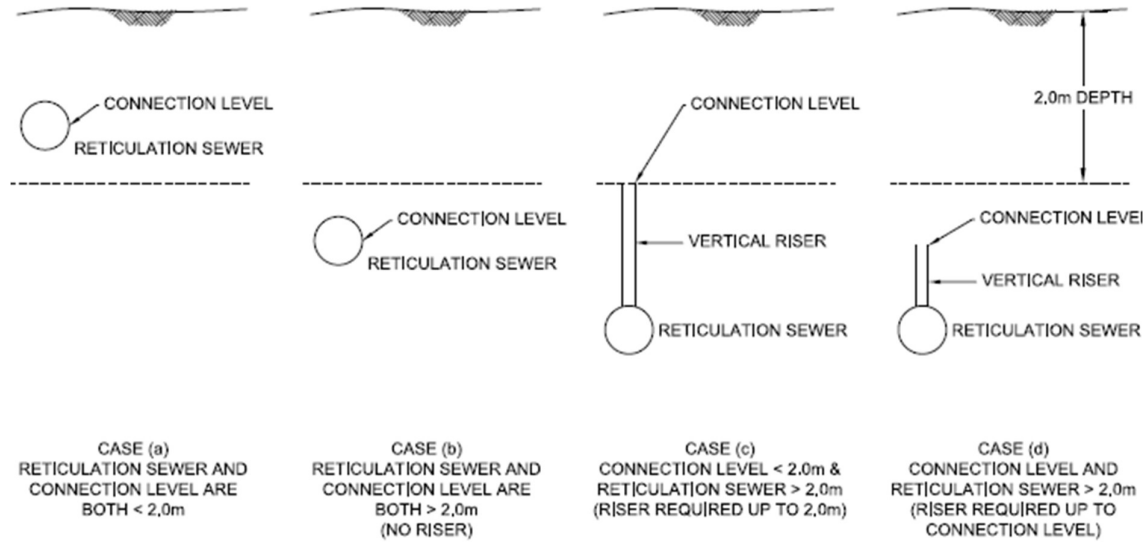


Figure 8 Depth of point of connection and use of risers.

The difference (centre-to-centre) in the depth of Connection Level as calculated in accordance with Section 18.5.3 and the sewer main equates to Vertical Drop of that property connection. The property connection sewer shall be designed in accordance with the layout presented in Engineering Guidelines Standard Drawings Sewer Series 1202.

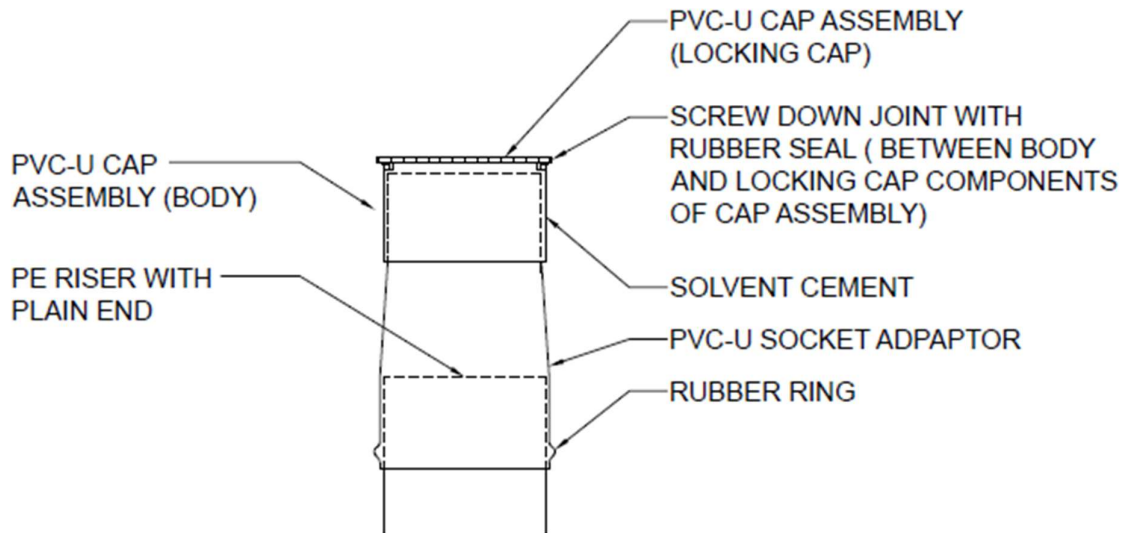


Figure 9 Typical PVC-U cap assembly and fittings

18.5.5 Soffit Requirement

The soffit requirement is the minimum height differential between the soffit of the receiving sewer and the lowest fixture of the house drain connecting to that point.

The minimum height difference is 1,200 mm which may be reduced to 900 mm where:

- The number of properties upstream is 10 or less, or

- The grade of the sewer downstream is steeper than 3.3%; or the overflow relief gully is installed immediately upstream of the inspection shaft or boundary trap.

In the situations where it can be demonstrated that this soffit cannot be satisfied or an alternative is not possible (i.e. set minimum floor level) consideration may be given to the installation of a reflux valve in the house drain on the house side of the junction.

If the 600mm cannot be achieved for all connections, then all connections shall be joined to the sewer via a pump. The pump is the property of the property owner.

18.5.6 Inspection Shaft

The property connection shall utilise the Buried Interface Method as shown in Engineering Guidelines Standard Drawings for Sewer Series SD 1202.

Each property connection sewer shall connect customer sanitary drain to sewer main via an inspection opening as a part of the customer sanitary drain. The inspection opening shall be located 1 metre inside the property boundary and in accordance with AS/NZS 3500.2.

18.5.7 Markings of Junctions and Sidelines

The position of each riser, junction or end of a sideline should be clearly marked by the Contractor on completion of backfilling and shall be no further than 1m from the front and side boundaries when the main is located within the road reserve or neighbouring lot and no further than 1m from the side boundary and the centreline of the main where the main is traversing the lot.

A red survey peg should be used to indicate the location of sewer junctions. The peg should be tied to an underground identification tape, connected to the sewer junction. The contractor should adjust the levels of pegs where necessary to conform to final surface level at the time of notification of completion.

As an alternative to providing a red survey peg, the vertical riser can be constructed. The sewer riser is to be marked red, solvent capped, protected from vandalism and easily identifiable for future internal sewer connection.

The position of each riser, junction or end of sideline, dimensioned relative to at least 2 adjacent property boundaries must be shown on Works As Executed drawings to allow location at future date. Distance to junctions from downstream manhole also to be indicated.

18.5.8 Access Chambers/Maintenance Holes

For the purpose of this Minimum Standard, 'access chambers' are referred to as 'maintenance holes or manholes' (MH).

Sewer maintenance holes are required at all changes of grade, changes in pipe diameter, deflections, line intersections, at all dead-ends exceeding 25 metres in length and at transition from pressure sewer to gravity sewer system.

Where sewers of different diameters intersect or join, the smaller pipe shall be laid so that its soffit is not higher than the soffit of the larger pipe; that is, the maximum depth of the smaller pipe shall result in level soffits between the two pipes.

The bases and shaft sections for maintenance holes may be either cast-in-situ (preferred) or precast. The developer is required to submit detailed drawings of proposed access structures for approval.

Step Irons to be installed in accordance with HC Standard Drawings for Sewer Series - 1204 Maintenance Holes.

Sewer maintenance holes should not be located in road carriageways.

An internal manhole drop between inlet and outlet is required is referenced in Table 39.

Table 39: Internal Manhole Drop

Deflection Angle	Drop (mm)
0°to 90°	30
90° to 120°	80

Deflections greater than 120° are not permitted.

Maximum spacing for maintenance holes should be as shown in Table 40.

Table 40: Spacing for Maintenance Holes

Pipe Size(mm)	Maintenance Hole Spacing (m)
150	80
225	100
300	120
375 and above	150

18.5.9 Existing Maintenance Holes and Services

Where the development is utilising existing sewer mains or junctions, the mains, maintenance holes or junctions must be upgraded to meet the current guideline requirements.

18.5.10 Sewer Easements

Easements are required over Council's sewer mains crossing private property. It is the responsibility of the developer to obtain sewer easements from any other land if required. (The Subdivision Certificate will not be released until the above requirements have been complied with).

The developer should transfer to Council any sewer easements provided in the subdivision and execute a transfer and grant of easement in favour of Council pursuant to Section 88B of the *Conveyancing Act 1919*, as amended.

The minimum width of sewer easement shall be 3.0m, this width may need to be increased depending upon depth of main, size of main, shared trench with other services.

Where a shared trench with stormwater, sewer should be located nearest a lot being served where practical.

18.5.11 Design Criteria

All lots are to be provided with a sewer junction, so placed that the whole of the lot can be gravity sewered.

A 150-millimetre diameter sewer junction is to be provided within each lot. The depth of the junction is to be such that any location within the lot can be drained to it via a pipe with a minimum 300 millimetres of cover laid at a minimum grade of 1 in 60.

18.5.11.1 Gravity Pipe Design

Sizing of gravity sewerage pipes should be in accordance with Table 41.

18.5.11.2 Design of System Components

The sewerage system components should be designed generally in accordance with WSA 02-2014, WSA 04-2005 and WSA 07-2007.

18.5.11.3 Maximum and Minimum Allowable Loadings – Reticulation Mains

The minimum size for gravity sewer mains is 150-millimetre diameter.

Gravity reticulation mains capacity should be greater than or equal to Peak Wet Weather Flow (PWWF) and grading sufficient to achieve self-cleansing velocity at Peak Dry Weather Flow (PDWF).

PWWF is the highest observed hourly flow following the design storm event (1 hour intensity, 1 in 2-year Average Recurrence Interval; see “Design Flows” below). PWWF to be adopted are:

- For undeveloped areas, PWWF = WSA 02-2014 (Current Version) Design Flow;
- For developed areas, PWWF should be the greater of the physically measured/assessed flow (where available) and the WSA 02-2014 (Current Version) Design Flow;
- For a mixture of developed and undeveloped areas, PWWF may be a combination of physically measured/assessed flow (where available) and WSA 02-2014 Design Flow, as directed by Council.

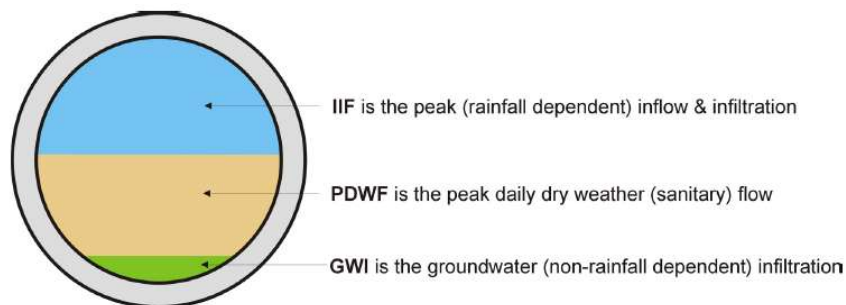
OR

The flow in a sewer comprises domestic sewage, industrial wastes, groundwater infiltration, storm inflows and rainfall dependent inflow.

Sewerage Flow is composed of the three components illustrated in the pipe cross section Figure 10, where the overall design flow (Ultimate PWWF) is represented by the equation:

$$\text{Peak Wet Weather Flow (PWWF)} = \text{PDWF} + \text{GWI} + \text{IIF}$$

The pipe shall be designed to suit the ultimate peak wet weather flow.



NOTES:

- 1 Components are indicative only and will differ due to location, rainfall, strata, pipe material and jointing methods and other factors.
- 2 The component shown as IIF is also the air space / ventilation allowance during dry weather flows.

Figure 10: Design Flow Estimations

Table 42 gives maximum and minimum allowable loadings for various diameter pipes.

The maximum acceptable grade for any sewer is 1 in 10, whilst the minimum acceptable grades are detailed in Table 42.

18.5.11.4 Values for Roughness

The values of roughness to be used in the design of gravity sewers are detailed Table 41 - Value of Roughness.

Table 41: Value of Roughness

Nominal Pipe Size (mm)	Full Flow – for estimation of Peak Hydraulic Capacity	Partial Flow – for estimation of Self-Cleansing Flows
150-300	k=0.6 mm	k=1.5 normal k=3.0 for control lines
300-600	k=0.6 mm	k=3.0 mm
Above 600	k=1.5 mm	k=6.0mm

Note: Control Lines are those lines which affect the overall depth of system.

Table 42: Maximum and Minimum Allowable Loadings

GRADING TABLE - GRAVITY SEWERS 150 - 600mm Nominal Size Pipelines																																											
Pipe Diameter (mm)	150						225						300						375						450						525						600						Pipe Diameter (mm)
Grade %	Tenements						Tenements						Tenements						Tenements						Tenements						Tenements						Grade 1 in						
	K	Min. 1.5	3.0	Max 0.6	Min. 1.5	3.0	Max 0.6	Min. 1.5	3.0	Max 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	Min. 3.0	Max. 0.6	K																
1.25		1	1	221																								80															
1.11		3	2	208																								90															
1.00		6	4	196	11	8	609																					100															
0.91		9	7	186	15	11	580																					110															
0.83		13	10	178	20	15	553	28	22	1225																		120															
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0.71		23	18	164	31	25	510	38	32	1129	39	2081																140															
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0.25								389	340	648	332	1199	347	1975	370	3006	396	4316										400															
0.22								577	507	608	448	1120	585	1855	475	2826	504	4060										450															
0.20								1175	1039	575	602	1066	747	1757	600	2674	628	3843										500															
0.18											819	1013	953	1670	748	2544	773	3656										550															
0.17				Normal flattest grade be adopted in reticulation design								1191	967	1226	1596	926	2430	940	3494									600															
0.15														1630	1531	1138	2331	1134	3351									650															
0.14														2829	1471	1400	2242	1362	3222									700															
0.13															1420	1732	2162	1628	3109									750															
0.13				Absolute limiting grade for pipeline designed to be cleaned by gravity flows												2186	2089	1948	3006									800															
0.12																2925	2024	2341	2926									850															
0.11																		2850	2825									900															
0.10																		5668	2673									1000															

Adopted from the "Manual of Practice: Sewer Design", Public Works Department, NSW

18.6 Rising Mains and Pumping Stations

18.6.1 Purpose

Velocity in the rising main should not exceed 3.0 metres per second and have a minimum of 0.6 metres per second, unless directed otherwise by Council.

18.6.2 Design Flows

The design flows should be calculated in accordance with Appendix C of WSA 02-2014 (Current edition). The following parameters shall be adopted:

- The Leakage Severity Coefficient shall be $C=1.6$, unless directed otherwise by Council.
- Design rainfall is the 1-hour duration rainfall intensity for an Average Recurrence Interval of 2 years ($I_{1,2}$)(mm/h) and shall be derived from Bureau of Meteorology's ARR 2016 Intensity–Frequency–Duration (IFD) web service, using the project site coordinates. Designers shall obtain the IFD data directly from the BoM online tool, extract the 1-hour, 2-year ARI intensity ($I_{1,2}$) in mm/h, and include the IFD report or CSV in their engineering design submission. Generic or region-wide rainfall values will not be accepted.
- The "peaking factor" (d) shall be: $d = 0.01(\log_{10}EP)^4 - 0.259(\log_{10}EP)^3 + 2.56(\log_{10}EP)^2 - 11.37(\log_{10}EP) + 20.78$ [Note, this is in accordance with the Gravity Sewerage Code of Australia, Regional New South Wales Edition, Version 1, Water Services Association of Australia.]

18.6.3 Rising Main Materials

Generally, the design velocity range in a rising main shall be between 0.6m/s and 3m/s.

The pipeline is to be graded to minimize the number of low points and high points in the pipeline.

The rising main discharge level shall be constructed to ensure that there is no free drop inside the receiving manhole. A gentle non-splash entry into the manhole is required, or an entry through a sideline riser upstream of the manhole.

All rising mains must be constructed from material which is compatible with Ductile Iron fittings.

Council may direct that any rising main should be constructed from PN35 Ductile Iron Cement Lined, spigot and socket, rubber ringed jointed pipe manufactured in accordance with AS/NZS 2280.

All cast or ductile iron fittings should be cement or epoxy lined and conform to AS/NZS 2544 and AS/NZS 2280 respectively. Isolation valves and scour valves are to be anticlockwise closing (ACC) and resilient seated, with stop valves to have a minimum pressure rating of Class 16.

Where it is proposed to use pipe material other than Ductile Iron the Developer will be required to show that the material proposed conforms as follows:

- Pipe is suitable to meet pressure requirements at the proposed location;
- Has the required minimum required pressure rating of PN16;
- Is compatible with Ductile Iron fittings;
- Fatigue and/or cyclical load testing indicates the material will meet a minimum 100 year design life;
- Will not be adversely affected, in terms of shape and strength by construction loading;
- Installation method to manufacturers instruction for minimum 100 year design life; and
- Complies with a relevant Australian Standard

18.6.4 Valves, Fittings and Vents

Each pump discharge line is to be provided with a reflux valve and Isolation valve, the Isolation valve is to be positioned upstream from the reflux valve.

An approved air valve is required at high points in the main.

A scour valve, line and pump out chamber is required to enable the rising main to be completely drained of sewage in accordance with Hilltops Council Engineering Guideline - Standard Drawing SD1201 Series).

The receiving manhole is to be vented.

The developer is required to submit detailed drawings of rising mains and receiving maintenance holes for approval.

18.6.5 Pump Stations

Wet-well capacity shall be sufficient for the total ultimate Peak Wet Weather Flow (PWWF).

Pumps shall be sized for a maximum of 10 starts per hour and shall provide a self-cleansing velocity of 0.7 m/s in the rising main.

Full stand-by pump capacity is required.

The minimum volume from top water level to bottom water level shall equal the volume pumped in 90 seconds.

The combined detention time in the wet well and rising main shall not exceed 4 hours.

All incoming lines to a pump station shall be fitted with a knife-type isolation valve at the end of the incoming line.

18.6.5.1 Configuration and Controls

Each pump station shall include:

- Two (2) wet-well pumps;
- Capability of delivering the ultimate PWWF;
- An automated control system alternating the duty pump on each cycle; and
- A manual override facility to allow operator selection of the duty pump.

18.6.5.2 Hydraulic and Maintenance Layout

All incoming lines shall be directed through a single maintenance hole located close to the wet well. A penstock valve shall be installed between the maintenance hole and the pump station to allow isolation for maintenance.

18.6.5.3 Telemetry and Electrical Control

The Developer shall provide telemetry compatible with Council's existing system.

Full details of the proposed telemetry installation shall be submitted to Council for approval prior to procurement or installation.

18.6.5.4 Pump Stations Access, Services and Site Requirements

An all-weather sealed/concrete access track suitable for a rigid truck and turning bay shall be provided.

A 25 mm metered water supply with a Reduced Pressure Zone Device (RPZD) backflow prevention device shall be installed adjacent to the pump station.

A 1.8m security fence shall be provided where required, subject to the location and the Director's direction.

18.6.5.5 Ventilation and Odour Control

Where a receiving manhole is located within 40m of a residence, a vent stack with an odour control unit shall be provided.

All other receiving manholes shall include a vent stack capable of accommodating a future odour control unit if required.

18.7 Pressure Sewer

Reference Drawings

- SD 1203 Sewer Series - Embedment & Trench Fill – Typical Arrangement
- SD 1205 Discharge Maintenance Hole – General Arrangement
- SD 1205 Design Layout – Typical Locality & Site Plan

- SD 1205 sheet 6 of 6 Property Boundary Kit – Typical Arrangement

Pressure sewerage system is a complete system in which macerated sewage is conveyed under pressure generated by pumping units located on each property to a sewage treatment facility or another part of the sewerage system.

18.7.1 General

The following is to be read in conjunction with the Council Pressure Sewer Systems Policy on Low Pressure Sewer Systems. These systems will be considered only where it is impractical to provide a gravity sewer system. The overall strategic sewer servicing of the catchment will take precedence over the ad-hoc servicing of individual lands.

The pressure system consists of components that include:

- A network of mains including pressure sewer laterals and property boundary kit assemblies. The system transports sewage from properties to a sewage treatment facility or to the gravity sewerage system.
- The pressure reticulation sewer are common Council owned pipes which transfer sewage from multiple properties to a discharge point in the sewer system;
- The pressure sewer laterals are Council owned mains that connect the pressure reticulation sewer main to a property boundary kit assembly.
- The Council owned property boundary kit is a fitting assembly that:
 - Connects a pressure sewer lateral to a property discharge line owned by the property owner; and
 - Provides a means of isolating the pressure sewer reticulation from a property discharge line and associated collection/pump unit. As a minimum, it consists of a non-return valve, access T and an Isolation valve. It is located 1m within the property being served by the system.

Ownership of all components upstream of the isolation ball valve belongs to the property owner. This includes the non-return valve, access T and the boundary kit box and lid and pipe work upstream. Isolation ball valve and pipe work down stream of are Councils responsibility.

The Developer's extent of works includes the supply and installation of the boundary kit and all downstream works. The onsite works upstream of the boundary kit are the responsibility of the property owner Refer to Figure 11 - Typical Pressure Sewer – House.

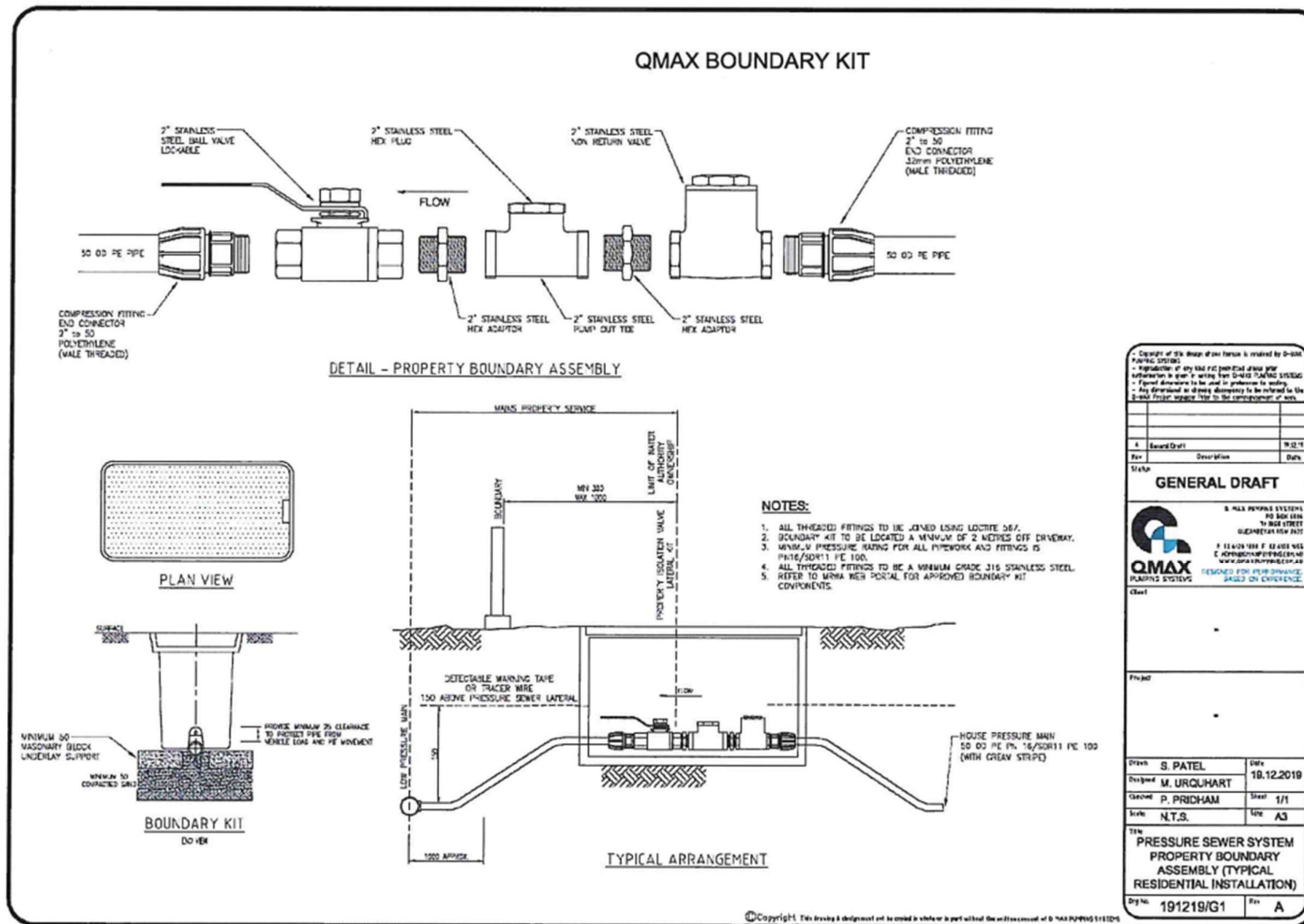


Figure 11: Typical Pressure Sewer – House courtesy of Qmax Pumping Systems – Property Boundary Assembly (Boundary Kit)

18.7.2 Standards and Regulations

All designs will be carried out in accordance with the WSAA Pressure Sewerage Code of Australia and all relevant Australian Standards. If those carrying out the design believe there is any conflict, then these matters should be raised with the Council Representative.

18.7.3 Reticulation Zones

Where the design is for large ongoing developments/ subdivisions the design is to utilise reticulation zones leading away from the connection point (or discharge point) to the existing reticulation system. All such zones should be clearly marked on the design drawings.

Where developments are to be staged the design must address the need for low, intermediate and high flow lines to service the development from the initial to the final stage.

18.7.4 Design Criteria

If the installation of low-pressure sewer in a development is the only feasible requirement the reticulation within the individual development will require a detailed design.

The developer is responsible for the design; however, the design will be subject to formal approval by Council. Council requires that persons with appropriate skills and experience, in low pressure sewerage design, undertake the design work.

Formal approval by Council is through the issue of a Subdivision Works Certificate.

18.7.5 Design Flows

The mains shall be designed to achieve a minimum velocity of 0.7m/s at least once in every 24 hours, for self-cleansing purposes.

18.7.6 Pump Duty Points

Pumps are required to meet the following duty points:

- Head = 45m
- Flowrate = 0.45l/s (through a 32mm HDPE discharge pipe)

The 45m head should be taken as the maximum head the pump is designed to accommodate (i.e. the total static head plus the friction losses that will occur in the designed reticulation system). The flow rate of 0.45l/s should be taken as the minimum flow rate the pump is capable of discharging under normal operating requirements. Higher flow rates are permissible. Design calculations showing the friction losses and the estimated static head are to be included in any submission to Council on the proposed installation of pressure sewerage systems. Council may require that some reticulation main sizes be increased if it believes the heads on the pumps are too high.

18.7.7 Mains and Fittings

The diameter of the pipes should ensure that effluent is stored in the pipelines for a minimal time. Ideally the effluent should be no older than 24 hours when it reaches the sewage treatment plant. It is mandated that where sewage is determined to be older than 24 hours that preliminary discussion be held with Council regarding odour suppression options.

18.7.7.1 Materials

The reticulation mains are to be:

- Of varying diameter (DN63mm – DN315mm) polyethylene pipes.
- Class PN 16 (unless otherwise stated in dedicated areas).
- Minimum lengths of the pipe rolls to be 100m.
- Readily available in the commercial marketplace so that additional lengths can be purchased for repair or extension purposes.
- Capable of being crimped if required to effect repairs; and
- Cream stripe black polyethylene pipe is to be used for pressure sewerage systems in accordance with WSA PS – 207S.

18.7.7.2 Valves and Fittings

The valves and fittings to be used on the pipelines need to be compatible with polyethylene pipe and the class of pipe used. The types of valves should also be readily available in the commercial marketplace and of a type compatible with the pumping stations.

The reticulation system must incorporate a number of designated isolating valves and may require the use of air valves. Details of their use (or non-use) must be provided to Council with the proposed design.

18.7.7.3 Flushing Points

A flushing point shall consist of a tee (in line) or 90-degree bend (end of line), a sampling valve located on a vertical riser and an isolation valve and quick connection coupling. All dead-ends to pressure sewers shall be provided with an end flushing point where the number of connections in a branch line exceeds five (5).

In line flushing points shall be provided:

- Downstream of isolation valves, except where there is a downstream flushing point within 100 metres.
- Where there is more than one upstream connecting line; and
- At intervals not exceeding 500 metres.

Flushing points shall be designed to allow for scouring/flushing with flow initiation from the end flushing points and progressively downstream via in-line flushing points to the discharge end of the network. Flushing points shall be located in pits with appropriate covers. The size of the pit shall allow for the adequate clearance between any part of the fitting and the pit to permit operation of the valve and the replacement of any component.

18.7.7.4 Pipe Joining

All pipes are to be joined by electro fusion or butt thermal fusion techniques in accordance with the manufacturer's requirements. Those carrying out the pipe joins are to be appropriately qualified, capable of demonstrating their experience with this technique and have the right equipment to affect the welds. Council will also consider butt welding of the pipes by persons with the appropriate qualifications, equipment and experience.

18.7.8 Depth and Location of Pipework

The mains are to be laid on a route that causes minimum disruption to the area involved. All pipework is to be laid within the footway allocation as detailed in the General Requirement section of these Minimum Standards and laid parallel with the property boundaries.

The pipe will be laid to a depth where there is a minimum 450mm of cover over the pipeline in the footpath and a minimum cover of 750mm in the roads.

The pipe can in most instances simply be backfilled with the excavated material where the trench has been dug by a trenching machine such as a ditch witch.

This assumes that the main is excavated in what are all soil conditions. Where rock or gravel is encountered in the trench or in circumstances where there are other materials that might puncture the pipe then the pipe is to have a minimum of 50mm of sand backfilling on all sides.

Where sand fill is required, the trench is to be excavated an additional 50mm with the pipe to be laid on top of this sand bed. The trench excavation will need to be wide enough to allow for the sand filling around the pipe.

Where it is difficult to gain the depth due to excavation difficulties, then the pipe is to be encased in a minimum of 100mm of concrete. The trench will need to be widened to accommodate this encasement. Plans showing details of the proposed concrete encasement must be provided to the Director for approval prior to encasement.

18.7.9 Road Crossings

All low-pressure sewer reticulation that crosses public roads must be within a suitable conduit. PN9, uPVC pipe of minimum 100mm diameter is required as a conduit.

Where the road is a sealed surface the pipeline route is to be excavated using under boring techniques. The pipe is then to be drawn through the excavation conduit in accordance with the appropriate Australian Standard.

For unsealed roads, excavation can be by either open trench excavation or under boring of the road. The under boring must be done with sufficient width of the road so as not to compromise the integrity of normal operation of the road carriage way and in accordance with the traffic management plans.

18.7.10 Location Markers

The locations of pressure sewerage pipes are to be marked in the following manner:

- A metal detectable tape complying with Australian Standard AS/NZS 2648 shall be laid with pressure sewerage pipes in accordance with the manufacturer's specifications.
- At a minimum such tape shall be continuous and capable of being energized; and A brightly coloured marker tape is to be laid 300mm above the top of the pipe. This marker tape shall indicate that there is a pressure sewerage system below it.
- Council's preference is that the tape be beige or cream and at least have the letters PS on it during the design phase a services location survey of the proposed pipeline route is to be undertaken to determine the proximity of other services to the pressure sewerage lines.

Where other services are parallel to the pressure sewer mains and these intrude into the pressure sewer system allocation, the designer will need to work with both Council and the other service provider.

Actions to be taken will be decided on a case-by-case basis. The mains should where practical, cross other services at as close to right angles as can be practically achieved.

18.7.11 Residential Access / Driveways

Where driveways are made of the following materials, the pipeline route is to be excavated using under boring:

- Sealed surfaces (irrespective of nature).
- Paved Surfaces; and
- Decorative Surface.

Where there is no defined driveway and the pipeline is installed by open excavation then the driveway is to be compacted as soon as possible thereafter to minimise the loss of access to the property. The Pipe Layer needs to provide a minimum of fourteen (14) working days' notice prior to constructing the works in that street.

The Pipe Layer may provide this notice by letterbox drop, but the information should include:

- Date the pipeline is to be constructed.
- Estimated time trenches will be open.
- Contact number for further enquiries; and
- Method of excavation.

18.7.12 Property Connections

The reticulation main is to be connected to the property at the same time as it is being installed. All properties will be connected to the reticulation system through the boundary kit at each property (refer Hilltops Council Engineering Guideline – Standard Drawings SD 1205 Series). Lines from the reticulation mains to the boundary kits will generally be perpendicular to the reticulation main. The boundary kit is to be located a maximum of 1m from the front and side property boundary.

All property connections are to be located adjacent to the side boundary with the lowest relative level. An additional non-return valve is to be used where a road crossing to service a property is required. This valve should be located near the pipe joint and there should be no pipe joints under the sealed road area.

OR

All properties will be connected to the reticulation system through the boundary kit, located in each property.

The Property Owner at the time of future connection is responsible for the works upstream of the boundary kit.

Lines from the reticulation mains to the boundary kits will generally be normal to the reticulation main. Any road crossing is to be normal to the road centreline.

The boundary kit is to be located a maximum of 1m from the property boundary from which the pressure pipe exits the property.

All property connections are to be located adjacent to the side boundary with the lowest relative level.

If a service is required to the far side of the road, then a lateral shall be installed in a conduit pipe. A 300 X 300mm (surface area) sand backfill shall be installed from the underside of the

conduit pipe to the surface, at the low end of the conduit pipe, to allow any leakage to come to the surface.

Figure 12 shows the general layout of such property connections to Council main.

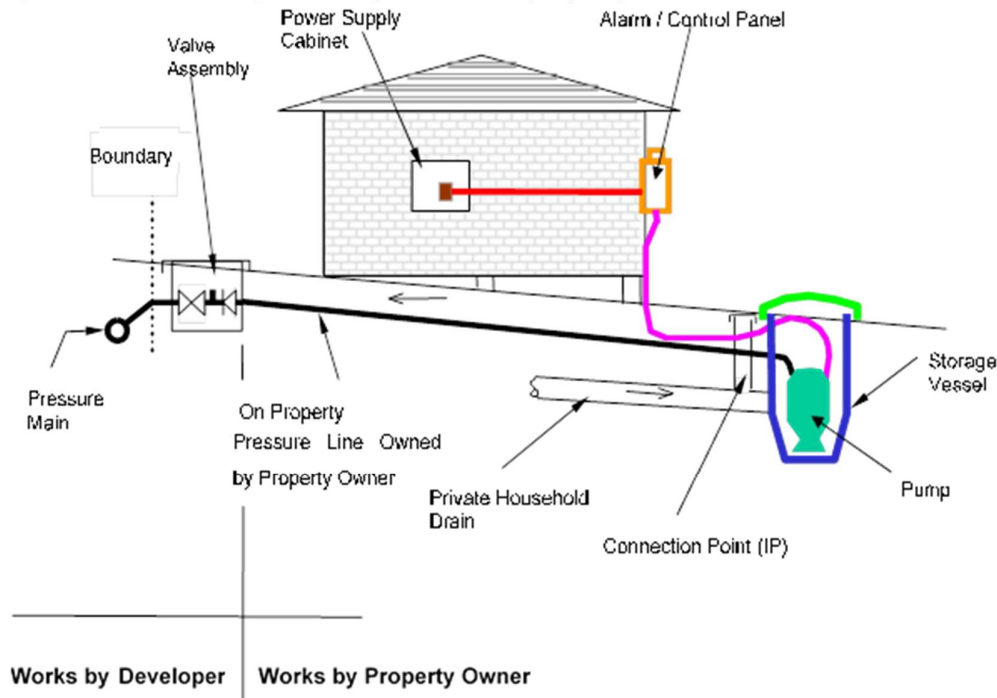


Figure 12: Typical Pressure Sewer – House Layout

18.7.13 Discharge Point to Council Sewers

Typically, this will be one of the following:

- Pumping Station in gravity reticulation system.
- Manhole in gravity reticulation system.
- Sewer Main sideline riser.
- Direct to Sewerage treatment plant.

The pressure system needs to be discharged to a point where the receiving system has sufficient capacity to receive the discharges from the pressure sewerage systems and transport it to the sewage treatment plant. A full analysis of the discharge point and downstream system capacity is to be provided with the design.

If the receiving systems capacity is insufficient during peak periods, then a controlled discharge structure can be constructed to store peak system discharges allowing these to discharge at a controlled rate and take advantage of the systems peak capacity. Such structures will be constructed on the basis of:

- Costs.
- System capacity.
- Odour suppression of any stored sewage (if required); and

- Ability to periodically clean the retaining structure.

18.7.14 Odour Suppression

Where unique system features, such as long rising mains to the treatment plant, the need for control storage devices etc are required, then the Designer must detail all odour suppression arrangements to be used.

Council has no preference for the type of odour suppression arrangements other than:

- They need to be effective for the instances required:
 - Low maintenance; and
 - They should be consistent with other Council odour suppression arrangements.

18.7.15 Supply of the Unit

Council will not supply or maintain any components of a pressure sewerage system.

The property owner or developer shall be fully responsible for the supply, installation, operation and maintenance of the complete pumping unit and associated fittings.

The proponent or developer shall obtain Council approval for the proposed pumping system to be installed, including the equipment type, layout, electrical control arrangement and connection details.

All works shall be undertaken at the full cost of the property owner or developer, and the system shall comply with Council's requirements and standard drawings.

Ownership of all components upstream of the boundary-kit inlet shall remain with the property owner.

Ownership of the non-return valve, isolating valve, boundary-kit box and lid, and all downstream pressure pipework shall rest with Council.

The Developer's extent of works includes the supply and installation of the boundary kit and all downstream works.

All onsite works upstream of the boundary kit are the responsibility of the property owner.

18.8 Building Over or Near Council's Sewer

18.8.1 Building Near Council Sewer

18.8.1.1 Relocation of Proposed Building

In all instances, the first option considered should be the relocation of the proposed building away from the existing assets. If this is not feasible, relocation of the assets is the next option to be considered.

18.8.1.2 Relocation of Assets

Council will only consider relocating existing assets if the applicant demonstrates that building away from the asset adversely restricts the land use. Any relocation works need to ensure all required design standards (cover, grade, position) are still met and that the capacity or functionality of the assets is not reduced. All costs for the relocation work including easements are at no expense to Council.

18.8.1.3 Relocation - Gravity Storm Water and Sewer Mains

Where approval to relocate a sewer or a stormwater drain is granted, the Applicant / Developer will be required to submit suitable drawings that describe the proposal. Relocation of the asset following approval is required before construction of the proposed building/structure may commence. The applicant will need to liaise with Council regarding the preservation of existing services and bypass pumping of sewage flows and protection of property during the interruption.

18.8.1.4 Relocation - Sewer Pressure Mains and Water Mains

Council may require that a pressure pipe be relocated away from the development.

18.8.1.5 Relocation - Easements

The Developer/Applicant may be required to acquire/provide an easement over a relocated asset, in accordance with Council's requirements.

18.8.2 Building Over an Underground Gravity Asset

18.8.2.1 Minimum Clearances

Minimum clearances permit Council to access its asset, should the need arise, without affecting the structural integrity of the works. In this regard:

The following Figure 13, Figure 14 and Figure 15 are included to show the clearances:

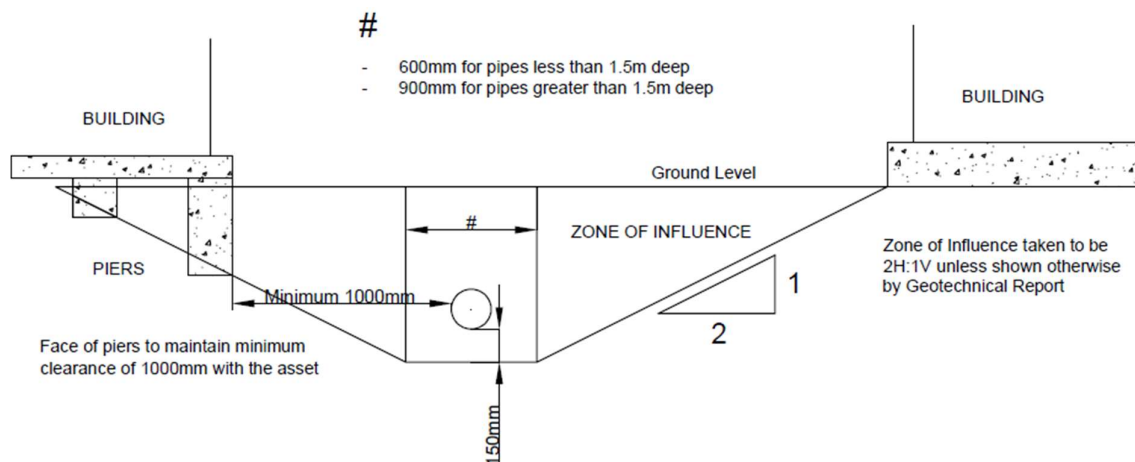


Figure 13: Zone of Influence

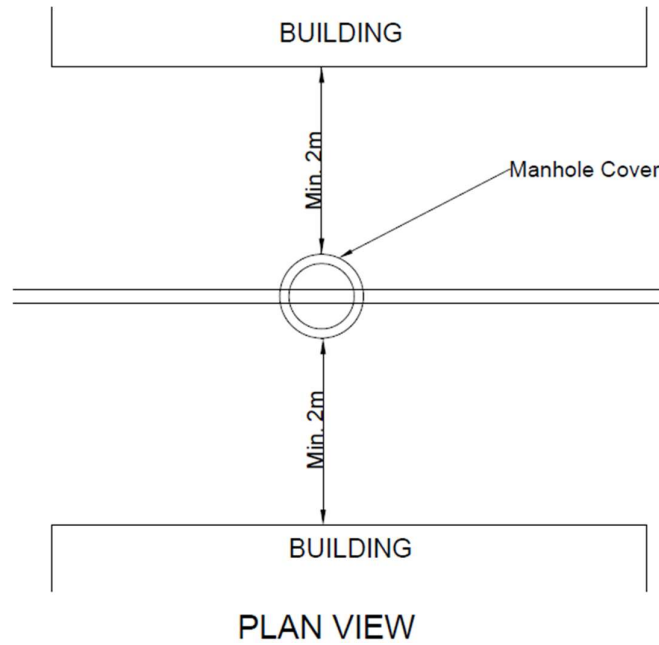


Figure 14: Clearance to Asset Access Points

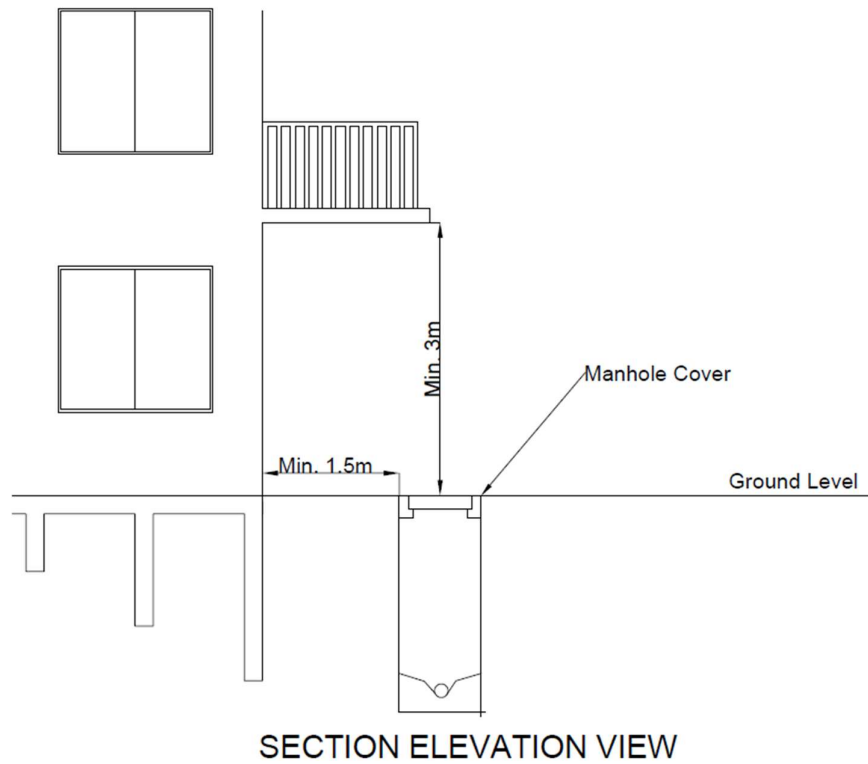


Figure 15: Pier and Beam Arrangement

In addition to the clearances shown above, the following points also apply:

1. The pier and beam footing system should be used with a minimum clearance between the edge of pier for the structure and the edge of asset of 600mm.
2. Minimum longitudinal clearances between the footings of building works and Council assets will be specified by Council's Representative.
3. The structure must be designed to permit access for pipe maintenance with removable panel flooring designed as a suspended slab (WSA 03-2002).
4. Clearances may also be specified from any concrete encasement (if requested) surrounding a pipeline.
5. Council may consider other forms of practical access to its assets. Such access should be clearly indicated on building/engineering drawings and should be designed by a Suitably Qualified Person.

18.8.2.2 CCTV Inspection

Council may require an application to build over a sewer or storm water main to include the following:

- A CCTV inspection of the subject main, undertaken by a Suitably Qualified or by Council at the applicant's expense.
- The results of the CCTV inspection are to be submitted to Council with the application. The inspection may be used as a dilapidation survey, with the developer required to fully fund any repair work required to rectify damage caused by their development.

18.8.2.3 Results of the CCTV Inspection

Depending on the results of the CCTV inspection, Council may require the Developer/Applicant to:

- Reconstruct the asset in its existing location using construction materials as specified by this document and in accordance with approved drawings or
- Reline the existing main by the engagement of contractors qualified to undertake such work. The name of contractor and the relining technique to be utilised will be submitted to Council for approval prior to work commencing. Work shall not commence until Council approval is issued.
- All works on the underground asset must be completed for the full extent between access chambers unless otherwise approved by Council.

An integrated approach of water, sewer and drainage assets needs to be considered in the application.

18.8.3 Types of Structures Where this Arrangement Applies

This section applies to the following categories of structures:

- Category 1. Heavy or Permanent Structures
- Category 2. Light Weight or Semi-Permanent Structures
- Category 3. Miscellaneous Structures (Rainwater Tanks, Driveways etc.)

Building high rise buildings over underground assets will be subject to a specific agreement with Council. Council will assess such applications on a case-by-case basis.

18.8.3.1 Category 1 - Heavy or Permanent Structures

These structures are typically constructed from masonry, brick, steel, timber and concrete. It is neither reasonable nor practical to remove or dismantle the structure for the purpose of carrying out underground asset repairs or refurbishment.

Examples of structures in this category include:

- Houses
- Factories
- Warehouses
- Brick Garages / Workshops / Open air bricked kilns, ovens, BBQs etc
- Structures that are permanently habitable or used as workplaces
- Sheds with a permanent floor
- In-Ground Swimming Pools
- Retaining walls greater than 1m in height

If Category 1 structures are to be built in the vicinity of sewers or stormwater drains, the requirements for protection of, and access to, the existing asset network must be followed.

18.8.3.2 Category 2 - Lightweight or Semi-Permanent Structures

These structures are typically of a type that would make it reasonable to remove / dismantle and re-erect if access to the main, by excavation, was required.

Examples of structures in this category include:

- Pergolas
- Garden sheds, non-permanent flooring
- Above ground pools (restrictions apply)
- Carports
- Timber / fibro / aluminium garages
- Glass houses / ferneries
- Barbecue facilities (See Category 1 for permanent bricked solid structures)
- Retaining walls less than 1m in height

These structures must be readily removable in the case of work being required to take place on Council's assets. Asset protection measures as outlined in section 18.8.4, may still apply.

Any future costs arising from the removal and subsequently reassemble of these structures will be at the owner's cost.

18.8.3.3 Category 3 – Miscellaneous

Structures in this Category do not normally require protection of the sewer mains.

Structures in this Category include:

- Fences
- Rainwater tanks

- Driveways (concrete, asphalt, pavers etc)
- Bitumen sealed and vehicle parking areas

If the minimum cover requirement for the underground asset has been met, then no special protection measures for the main should be required. However, if uncertainty exists in cases of anticipated high loadings or where the asset is less than minimum cover, advice shall be sought from Council.

In vehicle parking areas, the access structures will need to be assessed for:

- Conformity with the finished surface
- Prevention of drainage water entering the sewer
- Ensuring the chamber lid is of the right duty to withstand the vehicle loading

Any special conditions applied to Category 3 structures would be on a case-by-case basis and would include, in part, a stipulation that any removal and reinstatement of the structures (involved with Council accessing the main) would be at the cost of the owner.

Provisions required for access to the existing sewerage network still apply.

NOTE: Swimming Pools are discussed in section 18.12 and Retaining Walls are discussed in section 18.13.

18.8.4 Asset Protection Measures

If the construction of Category 1 or 2 structures will impose a load within an existing asset's zone of influence (see Figure 15), the developer may be required to carry out any combination of the following protection measures:

- Concrete encasement
- Pier and beam of foundations
- Provision of an encasing conduit around the carrier pipe

The protection measures may also be required due to other factors affecting the asset such as available cover.

18.8.4.1 Concrete Encasement

Concrete encasement of the carrier main may be required for the protection of the mains due to additional loads imposed by the works. Concrete encasement may also be required if Council's minimum cover requirements cannot be met.

Any concrete encasement is to comply with the Drawing SEW-1203 and the following specification:

- Only rubber ring jointed vitrified clay and PVC pipes may be encased in concrete. Permission may also be given to replace other types of pipes with PVC pipes prior to encasement depending upon the location and criticality of the lines.
- In trenches of material other than rock, encasing is to extend 150mm under, on both sides and on top of the pipe barrel. For trenches in rock, encasing is to extend 100mm under the pipe barrel, 150mm on top of the pipe barrel and for the full width of the excavated trench.
- Unless otherwise specified, all flexible pipe joints are to be maintained. The minimum length of the encasement will be the total length of the sewer that is affected plus a

minimum of 1000mm on each side plus any additional length to ensure encasement starts and finishes at a flexible joint. (Subject to soil conditions and depth of sewer this length may increase).

- If a manhole is less than 2 metres from the end of encasement, the encasement is to be extended up to the second flexible joint from that manhole.
- Backfilling of the trench with suitable material must not commence until at least 48 hours after placing the concrete.
- Concrete encasement shall not be poured integral with any other foundation or structure. Concrete should be minimum class N20 or N25 where a reinforced concrete design is required.

Sewer junctions that are permitted to be incorporated in proposed concrete encasement are to be upgraded to a rubber ring jointed junction in order to maintain flexibility at the junction branch.

- Where the encasing of sewers in adjoining properties is required, written approval from the adjoining owner to enter the property to carry out the works will be required prior to approval for works to commence being granted.

Council's Representative must inspect and approve the encasing setup prior to the start of the actual encasement work commencing and be present during the carrying out of the encasement work.

An inspection fee will be applicable based on Council's Fees and Charges document.

18.8.4.2 Pier and Beam Footings

Piering of the proposed structures footings may be required to transfer loads outside an asset's Zone of Influence. A certified design prepared by a Suitably Qualified Person will be required to accompany the footing / foundation designs. The drawing shall show the design of all footings, beams and piers and clearly note required clearances, ground levels and nominated soil classifications. The beams and slabs in the zone of influence should be designed as suspended structural elements.

The following requirements apply to footing piering:

- The building and its footings are to be designed in such a way that no building loads are transmitted to Council's asset and where possible, the pipe can be repaired or replaced at any time without affecting the stability of the building.
- Footings within an asset's Zone of Influence will require piering to a minimum depth of 150mm below the zone of influence of the affected asset or until solid rock is encountered.
- A minimum horizontal clearance of 1000mm (edge to edge) is required between any piers and the edge of the main. This clearance is also applicable to the edge of any pipe encasement.
- The use of displacement and screw pile construction methods will require approval by Council and may require additional clearances to existing assets as directed.

18.9 Zone of Influence

The Zone of Influence is an area extending both horizontally and vertically along the alignment of an underground asset. This area is considered as that part of the ground where:

- Settlement or disturbance of the ground surrounding the pipe may cause damage to buildings or structures above the asset.
- Loads from buildings or structures on the surface may have an impact on the buried pipe.

The zone of influence shall be determined by extending a line at an angle of 2H :1V, (2 Horizontal to 1 Vertical) to the surface, starting from the invert of the asset and half of the trench width measured horizontally from the pipe's centreline.

A steeper angle of repose (max 1H:1V) for stiff soils (clays etc) may be considered. Geotechnical investigations and a report from a Suitably Qualified Person is required to support such a request.

Refer Figure 16 showing the zone of influence.

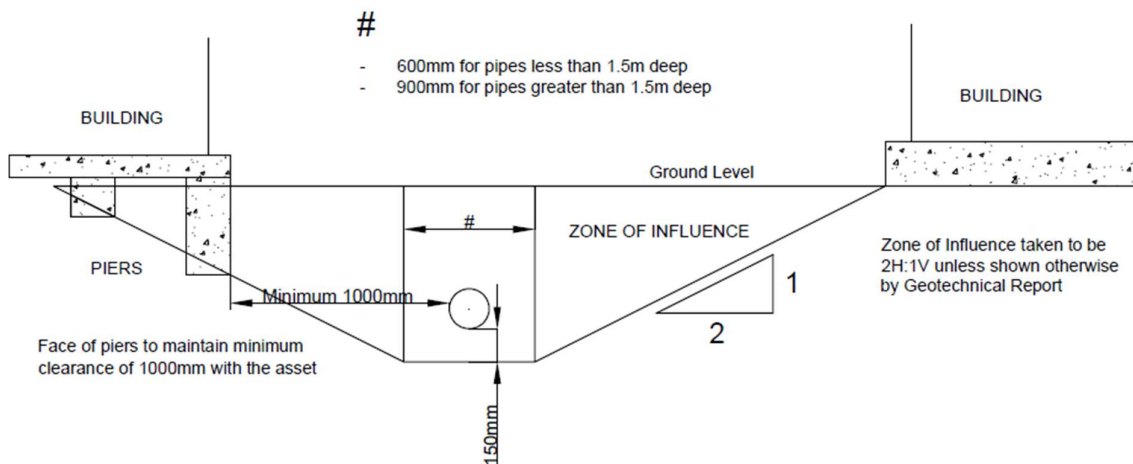


Figure 16: Zone of Influence

18.10 Clearances from Access Structures

A proposed structure shall not prevent future access to existing maintenance structures associated with the underground assets. These include manholes, maintenance shafts, inspection openings, and sewer dead ends, stormwater pits and inlet structures.

A minimum horizontal clearance of 1.5m is required around existing access structures as well as a minimum vertical clearance of 3m. The horizontal setback shall increase to 2m if two or three sides of an access structure are built around. The fourth side must always be open and accessible. Refer Figure 17 and Figure 18.

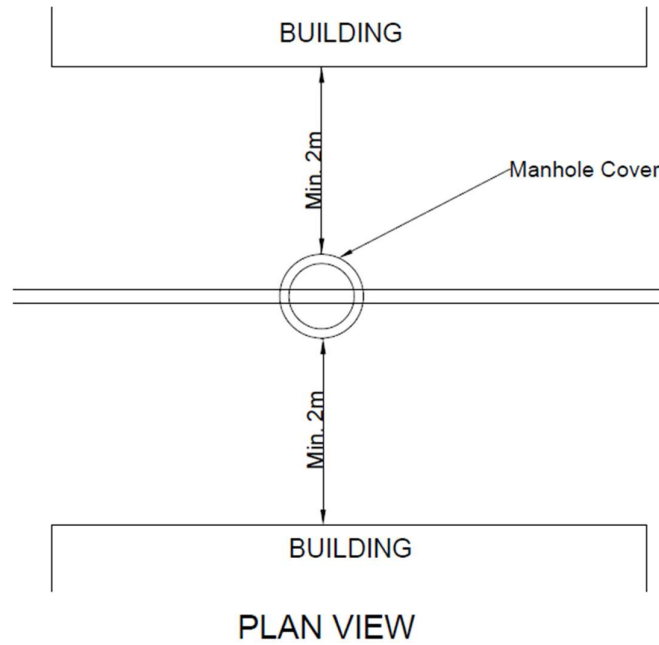


Figure 17: Clearance to Asset Access Points

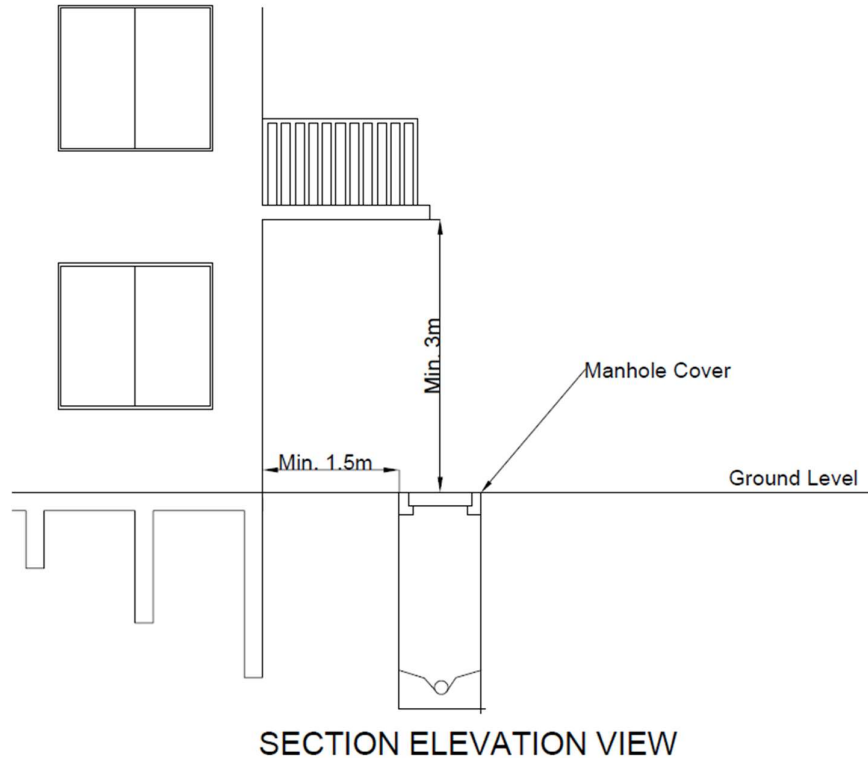


Figure 18: Pier and Beam Arrangements

18.11 Access Requirements

Council requires that all access structures for sewers and drains always be accessible in case of maintenance or emergency situations.

Developments on properties with sewer maintenance holes or lamp holes must provide at least 1.5 metre-wide clear access to the sewer structures i.e. along the boundary between fence and building.

This is necessary to allow Council staff access with their "tools of trade" such as cleaning rods and lid lifting equipment. Developments which locate sewer manholes or lamp holes in security areas must make suitable arrangements for access by Council's operations staff for maintenance or emergency work.

18.12 Swimming Pools and Retaining Walls

18.12.1 Above Ground Swimming Pool

Above ground pools that are without floor decking around the pool, and not constructed of concrete or fibreglass, are considered to be semi-permanent structures that are able to be removed on request to enable access to the asset. Special asset protection provisions are not required for these pools, if they are placed on the existing natural ground levels and minimum cover requirements to the asset are met.

Clearances to asset access structures still apply. All costs associated with removal and reinstatement of the pool for access to the asset main will be at the owner's cost.

Above ground pools with permanent decking are Category 1 permanent structures

18.12.2 In-ground Swimming Pool and Above Ground Permanent Structures

18.12.2.1 *In-ground Fibreglass Pool*

The following requirements apply to fibreglass pools:

- Minimum horizontal clearance from the pool to the face of sewer pipe of 1.5m
- If a fibreglass pool is constructed within the zone of influence of a sewer main it should be designed and certified as being self-supporting with footings founded below the zone of influence.
- No pool shall be located closer than 1.5 metres to any access maintenance structure (manholes etc). or within 1.5 metres of any sewer connection point including that of the adjacent property.

18.12.2.2 *In-ground Concrete Pool*

The following requirements apply to concrete pools:

- Minimum horizontal clearance from the pool to the face of sewer pipe of 1.5m.
- If the concrete pool is within the zone of influence of an asset, then the foundations of the pool shall be founded below the zone of influence (e.g. piers) to ensure the pool is self-supporting.
- No pool shall be located closer than 1.5 metres to a sewer maintenance structure (manholes etc). or within 1.5 metres of any sewer connection point including that of the adjacent property.

18.13 Retaining Walls

The construction of retaining walls is subject to the following requirements:

- Where the footings of a wall would encroach on the zone of influence the wall is to be designed not to impose a load on the asset's Zone of Influence.
- Generally, walls over 1.0m in height would not be permitted within 1m of the main.
- Minimum cover over the main is to be maintained or a Structural Engineer's assessment is required for protection of the main.
- The wall is to be set back at a minimum of 1m from the edge of a sewer maintenance structures or as per structural engineers assessment.
- A retaining wall less than 1.0m in height will be permitted over or within the Zone of Influence without the requirement for a Structural Engineer's design provided that:
 - the wall is at least 3m from an adjoining property or building/structure.
 - the wall would not be subject to vehicle loadings.

Any retaining wall crossing an asset, must be supported over the main with a reinforced concrete footing designed to ensure no loads from the wall are transferred to the sewer main i.e. pier and bridging beam footing. The beam must be designed as a suspended beam.

18.13.1 Filling Over Asset Mains

The allowable depth of fill that can be placed over an asset depends on the material type and stiffness class of the existing pipe. Site filling that increases the depth to the main above 2.5m will require an application to Council and subsequent approval. The application must include certification from a Suitably Qualified Person that:

- The loading imposed during or after construction will not adversely affect the asset.
- Remediation work proposed will prevent adverse loading on the underlying pipe.

The placing of fill in excess of 4m depth over Council's assets is not permitted (4m is a maximum depth for practical access) regardless of the structural capacity of the pipe. No access structure is to be buried under the fill.

Access structures are to be raised to suit finished ground level in conjunction with any site filling. Finished lid levels of maintenance structures, relative to ground level, will be advised by Council based on the land use and potential for surface flooding.

18.14 Excavations Over and Adjacent to Mains

18.14.1 Excavations

Excavation over or adjacent to an asset main is not to reduce the earth cover over the main to less than the minimum limits as detailed in section 18.14.

Any proposal to reduce cover over an asset to less than the limits imposed in these guidelines will require an application to Council and subsequent approval.

An application must include, among other things, certification from a Suitably Qualified Person that:

- The loading imposed will not adversely affect the underlying sewer.
- Remediation work proposed will prevent adverse loading on the underlying asset.

18.14.2 Earth Embankments

On sloping sites there is potential that earthworks on the downhill side of an existing pipe could cause land slip or erosion of soil providing cover and/or side support to an existing asset main.

Any proposed regrading of land on the immediately downhill slope of an existing asset main should be designed with a slope no steeper than 4 (horizontal) to 1 (vertical) to ensure future erosion and/or land slip does not reduce cover and/or support to the existing main. If a Council I a Council maintained reserve, the limit for mowing is 6 to 1 from a safety risk perspective.

Steeper embankments may be permitted where the embankment is certified by a Suitably Qualified Person and approved by Council depending on the areas prime function. If a Council maintained reserve, the limit for mowing is 6 to 1 from a safety risk perspective.

Retaining walls may be required to provide support down slope of existing asset mains if substantial regrading is proposed.

18.14.3 Abandoned Mains

Pressure or gravity mains which have been abandoned may remain in the ground, providing the abandoned mains are capped to prevent the movement of water Council may require certain abandoned mains to be backfilled with grout depending on size, material type and proximity to other structures.

Alternatively, the abandoned mains are to be removed, and the trench backfilled and compacted to at least 98% standard compaction. Note that Workcover requirements will govern the handling of any Asbestos Cement materials.

Abandoned Mains shall be surveyed for location and shown on works as executed plans for future referencing.

18.15 Planting of Trees

Tree roots can penetrate pipes through joints or damaged sections of pipes, causing blockages and subsequent overflows. As a result, certain species are not recommended to be planted near the mains. A list of the highest risk species is provided in Table 43.

Table 43: Tree Species to be Avoided

Botanical Name	Common Name	Damage Rating
Cinnamomum camphora	Camphor Laurel	Extreme
Ficus species	Fig Trees & Rubber Plants	Extreme
Populus species	Poplars	Extreme
Salix species	Willows	Extreme
Erythrina species	Coral Trees	Very High
Eucalyptus species	Large Gum Trees	Very High
Jacaranda mimosifolia	Jacaranda	Very High

Botanical Name	Common Name	Damage Rating
Liquidambar styraciflua	Liquidambar	Very High
Araucaria species	Norfolk Island & Bunya Pines	Very High
Brachychiton acerifolium	Illawarra Flame Tree	Very High
Casuarina species	Casuarinas	Very High
Melia azedarach	Australian White Cedar	Very High
Pinus species	Pine Trees	Very High
Platanus acerifolia	Plane Tree	Very High
Schinus molle	Pepper Tree	Very High
Ulmus species	Elms	Very High
Bougainvillea species	Bougainvilleas	High
Cortaderia selloana	Pampas Grass	High
Grevillea robusta	Silky Oak	High
Ilex species	Hollies	High
Lagunaria patersonii	Norfolk Island Hibiscus	High
Ligustrum species	Privets	High
Magnolia species	Magnolias	High
Nerium oleander	Oleander	High
Phoenix canariensis	Canary Island Date Palm	High
Phyllostachus species	Bamboos	High
Toxicodendron species	Rhus Trees	High
Lophostemon confertus	Brush Box, Tristania	High
Wisteria species	Wisteria	High

Appendix A. Preparation and Presentation of Design Drawings

A.1: General

All drawings prepared and submitted to Council shall comply with the relevant Council standards including TfNSW where relevant, to ensure that the drawings are suitably legible for review by Council's Representative and/or TfNSW.

A.2: Data Ownership

All data including digital or hardcopy associated with Development Applications concerning built assets that will become Council's asset after defects period or projects undertaken on behalf of Council becomes the property of Hilltops Council. This includes data provided at inception, during and upon completion of the development/project.

No data or information that is considered the property of Hilltops Council may be given to a third party without the formal written consent of Hilltops Council.

A.3: Design Drawings

A.3.1: General

All engineering drawings shall comply with the following to standardise the presentation of drawings to facilitate the approval and construction processes.

Engineering drawings shall be uncluttered and information clearly readable.

A.3.2: Size

As a minimum, the engineering drawing submission must include an electronic version in both native (i.e., CAD) and PDF format of all drawing sheets.

Engineering drawings shall be configured to an A series ISO standard sheet sizes (A0, A1, A3, A4, etc). Engineering drawings submitted for Development Consent shall be submitted as three sets at A3 size OR an equivalent PDF file.

A.3.3: Colour

When colour is used in a drawing and it is to be printed in colour, a note must appear on the title block stating that the drawing was created using colour and may appear incorrect if reproduced in greyscale or black and white. Colours used in drawings shall be visible and easily distinguishable and remain clear when the drawings are copied/printed. Yellow or shades of yellow are NOT to be used.

A.3.4: Text

The size of construction notes on the plans and drawings shall be minimum 3mm as printed on A3 sheets. The size of other lettering or numbering, including text within line types, shall be minimum 2mm as printed on A3 sheets. The minimum text size on A1 sheets shall be 2.5mm.

All annotation shall be carried out using CAD systems unless otherwise approved.

A.3.5: Line Work

All line work shall have a minimum line weight/thickness of 0.15mm.

A.3.6: Hatching

Hatch patterns and the scale of the hatch shall be easily identifiable and distinguishable. The appearance of the hatching shall match that shown in the legend. Hatch patterns must be consistent across all drawings.

A.3.7: Scales

Plan

- Road and Drainage: 1:500 minimum or as required for clarity. 1:100 or 1:200 for detailed road intersection plans.
- Water and Sewer: 1:500 minimum or as required for clarity. 1:100 or 1:200 for detailed plans see also adopted WSAA Code.

Detail

- As required for clarity.

Longitudinal Sections

- Generally, 1:500 Horizontal, 1:50 Vertical. Or other scales yielding a vertical exaggeration of 10.
- Vertical scale may vary in very flat or steep grades.

Cross Sections

- 1:200 Natural.

Kerb Returns

- As required for clarity, see A.3.11.5 Kerb Return Profiles.

Catchment Areas

- As required for clarity to suitably denote new and existing contributing catchments.

A.3.8: Drawing Title

All sheets must show the following information in the title block:

- Project/Property description.
- Service Provider/consultant/owner.
- Surveyor/Engineer and any certification registered number notification.
- Scale, bar scale and survey datum.
- Project/Development Consent number.
- Sheet number and amendment number/letter.
- Description of work.
- Drawing revision number and date of revision.

A.3.9: General Notes to be Shown on Development-Related Design Drawings

The following general notes shall be shown on the first or cover sheet of all Design Drawings:

- Drawing List and full site drawing of whole development showing
 - lot number,
 - existing road reserves and names adjacent to development,
 - proposed road number for construction referencing, area of proposed new road reserves (for each new road to be created) and
 - site locality sketch.

Other general notes to be shown either on cover page if space permits, or on following drawing sheet but not limited to:

1. All work is to be carried out in accordance with Hilltops Council's Engineering Guideline and to the satisfaction of Council's Representative.
2. The Service Provider is responsible for ongoing maintenance of erosion and siltation control measures.
3. All public utilities shall be clearly identified in the field prior to any civil works. Council does not accept any responsibility for damage or relocation costs to public utilities during construction of the development.
4. Prior to commencement of any work, a Notice of Intention to Commence - "Subdivision Works, Roads Act Approval Works and/or Approved Stormwater Drainage Works" must be lodged with Council.
5. It is the Service Provider's responsibility to ensure that all works shall be carried out in accordance with the Work Health and Safety Act 2011.
6. Permission to Enter, construct works and discharge stormwater onto adjoining properties shall be obtained and submitted to Council prior to the commencement of any works.
7. Pavement to be designed and certified by a practising consultant geotechnical engineer and submitted to Council for approval prior to the commencement of any works. Approved pavement design reports shall prevail over any design requirements or pavement details shown on the approved drawings.
8. These drawings shall be read in conjunction with the conditions stated in Hilltops Council's engineering plan approval correspondence and the conditions of the Development Consent.
9. If the standard or requirements for works shown on the approved drawings differ from that required by Council's Engineering Guideline, then the requirements of the Engineering Guideline generally will prevail. Clarification shall be obtained from Council's Representative if there is concern that the requirements of Council's Engineering Guideline may not be appropriate for a specific circumstance.
10. The Service Provider shall address all preconstruction requirements of Council's Engineering Guideline prior to commencement of any works.

A.3.10: Drawing List

The following is a list of the sheet types which are to be applied for detailed Design Drawing plan set:

- Cover and index.
- Typical cross sections including kerb profile, with line work extended beyond proposed boundary.
- Survey control plan and co-ordinates.
- Alignment control and detailed setting out.
- General plans and longitudinal sections for that asset i.e. Road, water, sewer etc.
- Pavement composition - build-up, jointing, subsurface drainage, etc.
- Cross sections.
- Kerb return profiles including Cul de sac heads.
- Property adjustments and/or driveway adjustments and longitudinal sections.
- Pavement marking, signposting and safety barriers.
- Drainage and subsurface drainage plans.
- Water main plan and associated elevations.
- Sewer main plan and associated elevations.
- Drainage longitudinal sections.
- Drainage calculation tables.
- Drainage catchment plan.
- Detailed drainage structures.
- Public utility services and proposed relocations.
- Erosion and sediment control plan.
- Detailed separate drawings for landscape (hard and soft), retaining walls, tree plantings

A general plan view to show all lots and display the multiple services i.e. underground services shall be included in the design drawing plan set.

A.3.11: Design Drawings

The following details shall be provided as a minimum set of Design Drawings.

A.3.11.1 Typical Cross Section Details, with Pavement Details and Subsurface Drainage

Typical cross sections as a minimum shall detail:

- Lane configuration and typical crossfalls.
- Typical location of road furniture (including streetlight poles and road safety barriers).
- Typical location of existing and proposed utilities.
- Pavement profile and reference to edge details.

- Subsurface drainage location.

A.3.11.2 Road and Stormwater Drainage Design Plans

Road and stormwater drainage design plans as a minimum shall detail:

- Site location plan.
- Centre line chainages.
- Chainages shall be aligned with the longitudinal section and generally run left to right across the plan, preferably readable in the direction of ascending chainages.
- North point to define orientation.
- Centre line bearing of straight sections and the radii of curves.
- Location, description and RL of benchmarks, to AHD.
- Position of proposed subsurface drainage lines (may be covered by note or shown on typical cross sections).
- Existing road names and proposed road number/names, property boundaries (existing and proposed) and lot and house numbers.
- Proposed type and alignment of kerbs including road and lane widths.
- Proposed dimensions, locations, material and types of all pavement marking (including raised retroreflective pavement markers) and signs, including sign size code, mounting height and lateral clearance requirements.
- Location and level of all existing services with construction notes relating to any necessary alterations or protection treatments (any service impacted by the project shall also be provided with levels).
- Location of proposed drainage structures with pits and headwalls numbered to correspond with drainage calculations and longitudinal section. For clarity, drainage details may be shown on a separate drainage plan.
- Lip or water run of kerb radius for all kerb returns (needs to be noted which one on drawings).
- Existing drainage structures and conduits including size, type and invert levels.
- Existing road feature level and location each side of the new road location sufficient to determine design grades and crossfalls to the new work.
- Existing survey features.
- Show merged proposed and existing contours at 500mm intervals, together with any relevant topographical features over the whole site. In flat areas or in watercourses and flood plains, 100mm intervals shall be provided.
- Limits of cut and fill batters of significance.
- Existing and proposed cadastral boundaries, including existing and proposed road reserve boundaries.
- All trees (greater than 3m in height) and shrubs within the road reserve and those within 3m each side of a proposed drainage line together with any others likely to be affected by the works, must be located and shown on the plan.

- Set out co-ordinates for all design centre lines, stormwater structures and any other design features requiring accurate set out information.
- Details of intersections showing kerb return chainages, kerb radii, road design centre lines, finished surface contours at 100mm intervals, or 200mm intervals if required for clarity, and set out co-ordinates.
- Location and details of permanent and temporary survey marks required for set out purposes.
- If the survey was undertaken by drone, total station or GPS equipment and at what tolerances the vertical and horizontal measurements are.

A.3.11.3 Longitudinal Sections for Roads

Longitudinal sections shall have chainages running left to right across the page. Other information to be shown shall include:

- Centre line chainages.
- Existing surface levels on the design control line.
- Design surface level on the design control line.
- Details of the vertical alignment, including crest and low points.
- Grades, size of vertical curves and chainage, and chainage and RL of intersection points.
- Datum RL of longitudinal section.
- Cut/fill transition zones to be shown
- Chainage, size and level of Public Utility mains and services (where information is available).

The longitudinal section shall extend for a minimum of 60m beyond the limits of pavement works, including along existing intersecting roads, to enable proper design tie-ins.

The longitudinal section of an offset cul-de-sac shall be curved to the centre of the turning circle and not in a straight line with an offset to the centre.

Hammerhead turning facilities shall have the long section continued along the main line of the facility. Where a cross section does not show the design centre line of the other turning arm, a long section shall be provided.

A.3.11.4 Cross Sections

- Cross sections must be shown at a maximum of 15m intervals and at key points for design purposes, e.g. where accesses require special design, where cover requirements over services are critical or where superelevation is required at the relevant transition chainages. Where appropriate for level control, designs may require cross sections at 5 or 10m intervals.
- Cross sections must be placed such that the lowest chainage occupies the bottom left corner of the sheet and run sequentially up the sheet in progressive columns towards the right.
- Cross sections must extend for the full road reserve width or for a sufficient distance to detail the proposed method of satisfactorily matching the design and existing surfaces.

- Additional cross sections shall be provided at each driveway access and be extended to detail transition to existing access or parking area.
- Provide sufficient existing cross section profiles and crossfalls to show transitions to proposed works where required.
- Details to be shown on cross sections shall include:
 - Road centre line chainage in bold print below each section.
 - Offset chainage from the pegged or design control line.
 - Existing surface RL.
 - Design surface RL.
 - Design crossfall (%).
 - Boxing of pavement layer.
 - Difference in design versus existing surface levels
 - Batter slopes (ratio Horizontal: Vertical).
 - Access grades (%).
 - Design centre line shift, offset crown or transitions where applicable.
 - Existing and proposed road reserve boundaries and levels within properties or regrading levels where required.
 - When instructed by Council's Representative, the position, size and level of any utilities in the vicinity of the work shall be included on the cross sections shown at a natural scale.

A.3.11.5 Kerb Return Profiles

- Each profile shall have a kerb return number (e.g. KR2) corresponding with a number shown on the plan view.
- Profiles shall represent lip line as viewed from the road in the direction of travel.
- Details to be shown shall include the following:
 - Horizontal and vertical scale. This scale must be selected to clearly show the convexity of the kerb profile.
 - Chainages. The running kerb lip chainage related to the profile together with the chainage related to the road centre lines. Chainages shall run left to right across the page.
 - Design level shall be lip of gutter.
 - Existing surface levels. Applicable road/street names/numbers leading into the profile.
 - An extension of 15m minimum beyond the tangent points to ensure a smooth profile is achieved.
 - Show location and number of proposed drainage structures.
 - Stormwater pit location and its identification reference number
 - Datum RL of kerb return.

A.3.11.6 Stormwater Catchment Analysis

When the design is within an identified flood affected area (existing or a future), the Service Provider shall refer to Section 4.15 Design in Flood Affected Area for details of Council's flood data requirements.

The following design details shall be provided as a minimum for all stormwater designs:

- Full catchment plan including contours is to be provided with all stormwater drainage designs.
- Catchment calculations showing the extent of the catchment including contributing areas outside the proposed works must be shown and all areas accounted for in the calculations.

Each pit sub-catchment shall have a reference number/letter which must be consistently used on the catchment plan, drainage calculations sheet, drainage longitudinal sections and kerb returns.

A.3.11.7 Stormwater Drainage Drawings

The stormwater plan may be incorporated on the road plan if space permits otherwise, it should be shown on a separate sheet orientated the same as the road plan sheet.

Details to be shown on the plan shall include:

- North point.
- Proposed road alignment.
- Pit/structure reference number/letter.
- Location of any applicable drainage structure.
- Pipe/box culvert sizes.
- Location and width of existing or proposed drainage easements.
- Location, size and capacity of controlling structure immediately downstream.
- Location of any utility services crossing the work.
- Typical sections and capacities.
- Location of any public utility service mains/services crossing influenced by the work.
- Note referring to type of bedding/backfill condition required in accordance with AS/NZS 3725 Design for installation of buried concrete pipes.

Details to be shown on the drainage profiles shall include:

- Drainage longitudinal sections must have the downstream end of the system on the left-hand side of the sheet with chainages to run left to right unless otherwise agreed with Council's Representative.
- Running chainage along the stormwater pipe at each pit structure and structures crossing the drainage line.
- Pipe design invert level.
- Pipe grade.
- Existing surface level.
- Existing invert of drainage where applicable (i.e. pipes, creeks, drains, etc).

- Finished surface levels.
- Pipe size, class and type.
- Type of bedding/backfill condition required in accordance with AS/NZS 3725 Design for installation of buried concrete pipes.
- Location, size and level of any public utility main or service that may be affected by the work and proposed treatment.
- Pit/structure reference number and type (to be shown above the section together with details of kerb inlet extensions and pit k value).
- Datum RL of the longitudinal section to AHD.
- Hydraulic grade line and levels including the receiving waters design level.
- Design flow and design storm Annual Exceedance Probability.
- Partial and full pipe velocity.
- Minimum friction grade of the design culvert.
- Trench stop or bulkhead locations and spacing as required.

A.4: Water and Sewer Drawings

When additional water and/or sewer infrastructure is required, the Design Drawings shall comply with the applicable Water Services Association of Australia (WSAA) Codes and Council's Water and Sewer Drawing Standards.

A.5: Environmental Management Plan

A.5.1: Environment/Vegetation Protection Drawing

These drawings shall show kerb lines, drainage, sewer and any other civil infrastructure that will require disturbance to the natural environment. These drawings shall show "NO GO AREAS" and proposed fence lines and types to ensure there is no disturbance outside the construction corridors.

A.5.2: Erosion and Sediment Control Drawing/Soil and Water Management Drawing

These drawings shall show the location, type and specific details of all sediment and erosion control devices. Soil and Water Management Plans and/or Erosion and Sediment Control Plans shall be prepared in accordance with Managing Urban Stormwater: Soils and Construction, 4th Edition, Landcom, 2004 (commonly known as "The Blue Book").

Details of sediment basins shall show the capacity, batter slopes, maintenance access, fencing, spillway, pumping requirements, dosing/flocculation requirements and stabilisation of the basin as a minimum. Details shall also show proposed staging of works, requirements for revegetation or progressive revegetation.

Stockpile sites and source control measures for the stockpiles shall also be detailed.

A.6: Retaining Walls

These drawings shall include as a minimum, the requirements listed in Section 9 - Design of Structures of this Design Guideline regardless of retaining type or height. Further structural details for various types of retaining walls can also be found within Council's Engineering Guideline - Standard Drawings.

Appendix B. Preparation and Presentation of Works As Executed Drawings

B.1: General

All drawings prepared and submitted to Council shall comply with the relevant Council standards (refer to Appendix A: Preparation and Presentation of Design Drawings) to ensure that the drawings are suitably legible for review by Council's Representative.

B.2: Specifics

Following the satisfactory completion of engineering works for a development, 'Works As Executed' (WAE) drawings prepared by a registered surveyor or professional civil engineer shall be submitted to Council's Representative.

Such drawings must be lodged and accepted by Council's Representative prior to the release of the Subdivision Certificate and progression to the defect liability period.

The WAE drawings shall be the original Approved Drawings (as modified), with the inclusion but not limited to the following items:

- Invert levels of all drainage and sewerage lines at entrance and exit of each pit.
- Location, class, size, grade, and material of all pipes and subsoil lines.
- Location and diameter of service conduits.
- Pavement thickness as constructed.
- Full cross section level check for each cross section that shall include, centrelines, shoulder LHS and RHS or kerb profile, table drain, footpath and boundary and cut/fill points.
- Footway widths at all TPs, centre of curves, and at each end of construction.
- Location of kerb laybacks and vehicular driveways.
- Location of stop valves, hydrants, water services, sewer manholes, sewer junctions, sewer rising mains, isolation valves, property pump systems, storm water and inter-allotment drainage pits.
- Site regrading details - finished surface levels at centre of front and rear boundaries.
- Contour depth of fill drawings with depths in 0.25m increments shaded or hatched.
- The location and level of any permanent survey marks.
- The location, level and compaction results of fill compaction.
- Show areas of lots which are un-sewerable (i.e., area where 1.6% fall from 0.6m below ground level to the sewer junction is not possible).
- The location of trees that have been removed.
- Location and details including footings, of all retaining walls.
- Type and location of trees planted.

B.3: Modifications or Deviations from Approved Drawings

Any modifications or deviation details to the approved drawings are to be marked up in red linework and font to illustrate that change prior to issuing the WAE set.

B.4: Works and Executed Drawings Certification

Each WAE drawing sheet must include the certification by a Suitably Qualified registered Surveyor or Civil Engineer from that Company issuing the final drawings.

The certification is to include their name, address, qualification, date and be signed, and the following statement as applicable to the drawing:

I certify that:

1. This survey is a true record of the works that have been constructed.
2. The roads horizontal and vertical positioning is as per Councils tolerances for such.
3. All drainage pipes and pits are located within the drainage easements and/ or reserves as shown on the final drawings.
4. All sewerage pipes and manholes are located within the sewerage easements and/ or reserves as shown on the final drawings.
5. All water mains and fittings are located within the water easements and/ or reserves as shown on the final drawings of subdivision.
6. Typical certification block from page 8 of this guide is shown below.

** I hereby certify that engineering works shown on the plan are Works-As-Executed and have been constructed in accordance with the plans and specifications approved by Council/Accredited Certifier (strike out whichever is inapplicable).*

Name:

Signature:

Capacity:

Date:

Appendix C. Checklist – Water Reticulation Design

Item No.	Description	Reference	Developer Confirmation	HC Confirmation	Comments
1	Water Servicing Strategy	17.5.2			
2	Future demands	17.5.3			
3	Water Reticulation Areas	17.6			
4	Low Flow (Trickle Feed) Water Supply areas	17.7			
5	Design Departure Application and Approval Documentation	3.4			

Appendix D. Checklist – Water Information to be Shown on Water Supply Design Drawings

Item No.	Item Description
1	General
1a	Cover Sheet with Locality Plan, List of Drawings and DA number
1b	Plans prepared in A1 format at a scale of 1:500
1c	Drawing Scale is shown on drawings as a bar scale
1d	Scale of Detail Drawings is shown as appropriate
1e	Schedule of Symbols
1f	Benchmark within 100 metres of development site is shown
1g	North Point shown
1h	Site topography is shown via contour lines
1i	Datum reference incl. Benchmark at A.H.D adopted by N.S.W. Dept. of Lands
1j	Each plan to be numbered with revision no. and revision schedule if required
1k	Road names or number reference
1l	Drawings to be signed by respective Consultant / Engineer
1m	Lettering, line work and symbols to conform to AS 1100
1n	Water mains to be shown on cross sections
2	Water Layout Plans
2a	Existing water mains and services are shown
2b	Lot boundaries and numbers shown
2c	Pipelines are numbered
2d	Pipeline centreline chainages are shown
2e	Pipeline diameters are shown

Item No.	Item Description
2f	Terminations at Cul-de Sac's through pathways, reserves or loop shown
2g	Location and size of water services shown
2h	Type and class of pipe work and fittings clearly indicated
2i	Location of hydrants, stop valves especially at intersections, scour valves, air valves and other fittings to be shown
2j	Alignment of mains and services in accordance with respective footway allocations for urban and rural residential
2k	Location of proposed easements reserves etc. incl. downstream if required
2l	Location of all drainage lines, sewer lines and other utility lines crossing the mains to be shown
2m	Limit of construction to be shown including staging
2n	Mains to be extended to the full length of the subdivision
2o	Service connection to each block
2p	A hydrant is to be located at dead ends
2q	Hydrant spacing to be as per Minimum Standards
2r	Thrust blocks to be indicated where required
2s	Water services at right angles to road centreline and parallel to the radius on curves and in Cul-de-Sac ends
2t	Metal detectable tape/cable to be shown when non metallic pipe is proposed
3	Water Longitudinal Sections
3a	Sections are drawn at scale of 1:500 horizontal and 1:100 vertical
3b	Levels to be shown at 20m chainage intervals, high and low points and pipe junctions
3c	Chainages as per layout plan
3d	RL of existing surface, design surface and pipe invert at each location of 3b above and at major variations in natural surface such as roads, gullies etc.
3e	Location of hydrants, stop valves, scour valves, air valves and other fittings
3f	Design grades including extent of each gradient

Item No.	Item Description
3g	Pipe diameters and material type and class to be shown
3h	Air valves or hydrants at high points
3i	Scour valves at low points
3j	Location and size of existing and proposed services and utilities crossing the main complete with invert levels
3k	Sections to be taken along intersecting roads for a sufficient distance to allow connection design
3l	Trench stops shown as required on steep grades
3m	All new water services to be shown
4	Miscellaneous
4a	Show differing water supply zones if applicable
4b	Design is satisfactory for future extension
4c	Pipe sizes conform to current strategies for future development
4d	Detailed engineering drawings are required for any structures such as reservoirs and pumping stations proposed for construction in conjunction with water supply works
4e	All allotments including areas set aside for recreation to be provided with a reticulated water supply sufficient for both domestic and fire fighting purposes except where trickle flow has been determined
4f	Engineering plans and subdivision plans agree
4g	Engineering conditions of consent included in design plans
4h	Water service sizes determined in accordance with National Construction Code – Volume 3 Plumbing Code of Australia and AS/NZS 3500
4i	Mains to be designed to satisfy minimum cover requirements
4j	Minimum pipe size is 100mm diameter for residential and 150mm diameter for commercial and industrial areas.
4k	All details conform to Standard Drawings including water services, connection details, Hydrant and Stop Valve design, Thrust blocks and Trench design

Appendix E. Checklist – Sewer Design

Item No.	Description	Reference	Developer Confirmation	HC Confirmation	Comments
1	Sewer Servicing Strategy	18.4.2 & 18.4			
2	Excavation or Building adjacent to or over Existing Sewer Mains	18.4.5			
3	Pumping Stations and Rising Mains	17.6			
4	Maximum and Minimum Allowable Loadings – Reticulation Mains	18.5.11.3			
5	Pressure Sewer	18.7			
6	Design Departure Application and Approval Documentation	3.4			

Appendix F. Sewer Information to be Shown on Sewer Design Drawings

Item No.	Item Description
1	General
1a	Cover Sheet with Locality Plan, List of Drawings and DA number
1b	Plans prepared in A1 format at a scale of 1:500
1c	Drawing Scale is shown on drawings as a bar scale
1d	Scale of Detail Drawings is shown as appropriate
1e	Schedule of Symbols
1f	Benchmark within 100 metres of development site is shown
1g	North Point shown
1h	Site topography is shown via contour lines
1i	Datum reference incl. Benchmark at A.H.D adopted by N.S.W. Dept. of Lands
1j	Each plan to be numbered with revision no. and revision schedule if required
1k	Road names or number reference
1l	Drawings to be signed by respective Consultant / Engineer
1m	Lettering, line work and symbols to conform to AS 1100
1n	Sewer mains to be shown on cross sections
2	Sewer Layout Plans
2a	Catchment area plan including sub-catchments and areas is submitted
2b	Existing sewer mains, junctions, side lines and manholes are shown
2c	Lot boundaries and numbers shown
2d	Sewer main lines and manholes are numbered
2e	Pipeline centreline chainages are shown
2f	Pipeline diameters are shown

Item No.	Item Description
2g	Dead end length to conform with Minimum Standards
2h	Side lines to conform with Minimum Standards
2i	Type and class of pipe work and fittings clearly indicated
2j	Alignment of mains, side lines, junctions, dead ends, manholes etc. to be shown
2k	Location of mains etc. in accordance with respective footway allocations for urban and rural residential to be shown
2l	Location of proposed easements reserves etc. incl. downstream if required
2m	Location of all drainage lines, water mains and other utility lines crossing the mains to be shown
2n	Limit of construction to be shown including staging
2o	Mains to be extended to the full length of the subdivision
2p	Junction to each block slope type if main is within property, square type if main is external to property
2q	Spot levels as necessary at the lot extremities to show that the whole of the lot can be sewered
2r	Manhole spacing to be in accordance with maximum spacing according to main size
2s	Rising mains to be shown with appropriate details according to Minimum Standards
3	Sewer Longitudinal Sections
3a	Sections are drawn at scale of 1:500 horizontal and 1:100 vertical
3b	Levels to be shown at 20m chainage intervals, manhole locations, dead-ends for gravity mains and high and low points for rising mains
3c	Chainages as per layout plans
3d	RL of existing surface, design surface and pipe invert at each location of 3b above and at major variations in natural surface such as roads, gullies etc.
3e	Design RL of all inlet and outlets at each manhole and all changes of grade
3f	Design grades including length of each gradient between manholes
3g	Pipe diameters and material type and class to be shown

Item No.	Item Description
3h	Air valves and scour valves on rising mains at respective low and high points
3i	Minimum cover requirements have been achieved
3j	Location and size of existing and proposed services and utilities crossing the main complete with invert levels
3k	Sections to be taken along intersecting roads for a sufficient distance to allow connection design
3l	Trench stops shown as required on steep grades
4	Miscellaneous
4a	Design is satisfactory for future extension
4b	Pipe sizes and design conform to current strategies for future development
4c	Detailed engineering drawings are required for any rising main structures such as pumping stations and specialised manholes and vents proposed for construction in conjunction with sewer supply works
4d	Sufficient capacity in downstream reticulation system to cater for development
4e	Engineering plans and subdivision plans agree
4f	Engineering conditions of consent included in design plans
4g	Junctions to each lot to comply with the soffit requirements in accordance with N.S.W. Code of Practice for Plumbing and Drainage 2006
4h	Mains to be designed to satisfy minimum cover requirements
4i	Minimum pipe size is 150mm diameter Gravity Sewer
4j	Pressure sewer designed in accordance with WSA guidelines
4k	All details conform to Standard Drawings including twin lift sewer manhole covers, drop structures, junction thrust restraints and trench design

Appendix G. Stormwater Information to be Shown on Stormwater Design Drawings

Item No.	Item Description
1	General
1a	Cover Sheet with Locality Plan, List of Drawings and DA number
1b	Plans prepared in A1 format at a scale of 1:500
1c	Drawing Scale is shown on drawings as a bar scale
1d	Scale of Detail Drawings is shown as appropriate
1e	Schedule of Symbols
1f	Benchmark within 100 metres of development site is shown
1g	North Point shown
1h	Site topography is shown via contour lines
2	Drainage Layout Plans
2a	Catchment area plan including sub-catchments and areas is submitted
2b	Existing services and drainage structures are shown
2c	Lot boundaries and numbers shown
2d	Pipeline or table drains are numbered
2e	Pipeline or table drain centreline chainages are shown
2f	Pipeline diameters or table drain cross-sections are shown
2g	Kerb or table drain profiles are clearly nominated
2h	Location of pits shown
2i	Type and size of pits clearly indicated
2j	Location and dimensions of any proposed easements or drainage reserves is shown
2k	Location of major system overland flow path shown
2l	Natural drainage paths are shown

Item No.	Item Description
2m	Location of natural watercourse to be drained to is identified
2n	Location of any retention, detention or water quality devices is shown
3	Drainage Longitudinal Sections
3a	Longitudinal sections are drawn at scale of 1:500 horizontal and 1:100 vertical
3b	Longitudinal section shows the following;
i)	Chainages
ii)	RL of existing surface at each inlet structure, outlet structure, pit and/or change of grade
iii)	Design RL of all inlet and outlet structures; pit, pipe and table drain inverts, pit inlets and all changes of grade
iv)	Design grades including length of each gradient
v)	Pipe diameters and classes and/or table drain capacities is shown.
vi)	Hydraulic Grade Line Analysis results as per AR&R
vii)	Location of existing and proposed services and utilities
4	Open Channel Drainage Cross-Sections
4a	Cross-sections are drawn at scale of 1:100 natural
4b	Cross sections show the following at no more than 20 metre intervals and at all intermediate changes of grade or profile;
i)	Chainages
ii)	RL of existing surface
iii)	Design RL of open channel invert and top of batters
iv)	Batter slopes of open channels are shown
v)	Section profiles of all open channels is shown
vi)	Details of low-flow pipes and/or lined inverts is shown
vii)	Details of Sub-Soil Drainage (if required)
4c	Sections of pits including details of access covers and access provisions is shown
4d	Scour protection details shown

Item No.	Item Description
5	Retention/Detention Basins
5a	Contours shown
5b	Grades of batters
5c	Depth indicated with spot levels
5d	Basin elevation / volume relationship at 100mm intervals
5e	Surface area tabulated (where applicable)
5f	Crest width
5g	Low level outlet details
5h	Scour protection
5i	Signage – depth markers, warning signs,
5j	Safety in design report
5k	Batter slopes, depth and typical section of any retention/detention structures is shown
5l	Spillway Capacity – Q100
6	Miscellaneous
6a	Location and details of any Water Quality devices is shown
6b	Location and details of any batter catch-drains
6c	Details of the type of vegetation to be used on batters
6d	Scour protection to all outlet structures is shown