CAMDEN COUNCIL

ENGINEERING DESIGN SPECIFICATION

November 2017

VERSION REGISTER

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2017 DRAFT		Review and update of current Design Specification 2009	Nov 2017

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3411	2002	Supply of Guide Posts (Timber)
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REFERENCE		
RMS (2002)	RTA Guide to Traffic Generating Developments V2.2	
RMS (2013)	RMS TDT 2013/04 - Updated Traffic Surveys	
RMS (2005)	RTA NSW Bicycle Guidelines V1.2	
RMS (2010)	RTA Traffic Control at Work Sites V4.0 Issue 2	
RMS (2000)	RTA Supplement to Australian Standards 1742 - Manual of Uniform Traffic Control Devices	
RMS (2008)	RTA Delineation	
RMS	RMS sign Register (website)	
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RMS (2004)	RTA "Concrete Roundabout Pavements: A Guide to their Design and Construction "	
RMS	RMS Form 76 (supplement to the AUSTROADS guide)	
RMS	RMS 'Concrete Pavement Manual'	
AUSTROADS (2009)	AGRD - Austroads Guide to Road Design (Parts 1 to 8)	
AUSTROADS (2012)	AGPT02/12 - Austroads Guide to Pavement Technology - Part 2 Pavement Structural Design	
AUSTROADS (2006)	APT47-06 - Austroads Revision of Guide to traffic Engineering Practice Part 8 : Traffic Control devices	
AUSTROADS (2015)	AGTM - Austroads Guide to Traffic Management (Parts 1 to 13)	
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ARRB (2005)	SEA002 - Transport Research 'Sealed Local Roads Manual – Guidelines to Good Practice for the Construction, Maintenance and Rehabilitation of Pavements'	
1987 (Reprint 1998)	Australian Rainfall & Runoff	
2010	Australian Standard and Disability Standards for Accessible Public transport	
1992	Australia's National Strategy for Ecologically Sustainable Development	
CC&AA (2004)	T51 - Guide to Residential Streets and Paths	
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DSC (2012)	DSC3A to DSC3G Dam Safety Committee Guides	
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NSW Police	Crime Prevention through Environmental Design (CPTED) principles and protocols	
NSW Police	Safer by Design	
2004	NSW Planning Guidelines for Walking and Cycling	
1999	98/7 - Managing Urban Stormwater Using Constructed Wetlands (2nd edition)	
2013	Policy and Guidelines for fish habitat conservation and Management (update)	

2005	NSW Floodplain Development Manual
NSW Rural Fire Services	Planning for Bushfire Protection
1993	NSW State Rivers and Estuaries Policy
2009	Guide to Codes and Practices for Streets Opening (7th edition)
1998	Constructed Wetlands Manual (Vol1 & 2)
2011	NSW Bus Infrastructure Guide (Issue 2)
2010	Disability Standards for Accessible Public Transport 2002 (as amended)
2004	Managing Urban Stormwater - Soils and Construction (Vol 1) (4th edition)
2002	Map of Salinity Potential in Western Sydney
2002	Guidelines to accompany Map of Salinity Potential in Western Sydney
OEH	Local Government Salinity Initiative Publications (various)
2004	Western Sydney Salinity Code of Practice
LGSI (2002)	Site Investigations for Urban Salinity
LGSI (2002)	Indicators of Urban Salinity
LGSI (2003)	Introduction to Urban Salinity
LGSI (2003)	Roads and Salinity
LGSI (2002)	Broad Scale Resources for Urban Salinity Assessment
LGSI (2003)	Building in a Saline Environment
LGIS (2004)	Booklet No.7 - Waterwise Parks and Gardens
OEH (2017)	Processes of Salinity (Website)
Camden Council	Camden Council's DCPs adopted by Council
Camden Council (2017)	Camden Council's Engineering Construction Specifications
Camden Council (2017)	Camden Council's Engineering Design Specification
Camden Council	Camden Council's Local Environmental Plan
Camden Council (2006)	Landscape and streetscape Elements Manual for Camden
Camden Council	Camden Council's Stormwater Drainage Asset Management Plan
Camden Council	Camden Council's Street Lighting Guidelines
Camden Council	Camden Council's Floodplain Policy
Camden Council Policy (2006)	Camden Council's Flood Risk Management Policy No. 3.19
Camden Council Policy (2004)	Building in Salinity Prone Environment Policy No. 1.15
Camden Council Policy (2001)	Erosion and Sediment Control Policy No. 3.11
NCC (2016)	NATIONAL CONSTRUCTION CODE Vol 2
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NCC (2016)	NCC 3.2.2.2 (Filling Under Concrete Slabs)

NCC (2016)	NCC 3.3.4.0 (Damp Proof courses – Material)
2010	FN-1181 - Fish Friendly Waterway Crossings Policy and Guidelines
	Endeavour Energy document SPJ 4004 Network Connections Contestable Works General Terms and Conditions 'Section 6 - Public Lighting Assets '
2004	Water Sensitive Urban Design - Technical Guidelines for Western Sydney
2006	Australian Runoff Quality
AMCORD (1995)	AMCORD (Australian Model Code for Residential Development) 'A National Resource document for Residential Development'
ACTS/Council Policies	
1979	EP&A Act
1993	Local Government Act
1997	Protection of the Environment Operations Act (as amended)
2000	Water Management Act No 92
1993	Roads Act (as amended)
1938	Soil Conservation Act
1978	NSW Dams Safety Act

GLOSSARY

1(V):6(H) refers to a slope of 1 vertical to 6 horizontal.

AC refers to asphaltic concrete.

Accredited Certifier refers to a person who is accredited by an accreditation body under section 109T of the Environmental Planning and Assessment Act, 1979 (as amended) in relation to matters of a particular kind.

AEP refers to the Annual Exceedance Probability, which is the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.

AHD refers to Australian Height Datum and is the datum to be used for all levels.

AMCORD (Australian Model Code for Residential Development) refers to the Commonwealth of Australia publication 'A National Resource document for Residential Development' 1995

Applicant refers to any person/s, company or entity being the owner, or representing the owner or applicant, for the purpose of applying for approval to construct the Works. The applicant may also be the Council.

Approved material refers to materials approved by the Council Engineer before use in or on the work.

AR&R refers to the 1987 edition and 1998 reprint of Australian Rainfall and Runoff prepared by the Institution of Engineers Australia.

ARQ refers to Australian Runoff Quality, currently in draft format, prepared by the Institution of Engineers Australia.

AS refers to the designation used for Australian Standards published by the Standards Association of Australia and being current at the time of application.

AUSTROADS refers to association of Australian and New Zealand road transport and traffic authorities.

NCC refers to the National Construction Code Vol 2 by the Australian Building Codes Board (this has replaces the BCA).

CBR refers to California Bearing Ratio.

Certifying Authority refers to an entity either being a consent authority, the Council or an accredited certifier that with the benefit of a development consent or complying development certificate for development involving building work or subdivision work may make various certificates under the EP&A Act for a development.

Consultant refers to a company or individual engaged by the applicant, Council or superintendent to provide advice or services in a particular field of expertise as part of the works proposed by the Applicant and as cited and approved by Council in a Construction Certificate.

Contractor refers to a company or individual engaged by the Applicant, Council or superintendent to undertake a specific job as part of the works proposed by the applicant and as cited and approved by Council in a Construction Certificate.

Council refers to Camden Council as represented by its employees or as defined in the EP&A Act can also be referred to as either a Certifying, Consent, Principal Certifying and Determining Authority. Under the Roads Act 1993 the Council is also the Roads Authority.

Council's Engineer refers to either the Land Development Engineer or the Director of Infrastructure Services or similar title, of Camden Council or a representative thereof unless otherwise stated.

CPTED refers to Crime Prevention through Environmental Design.

DC or Consent refers to the Notice of Determination giving subdivision or development approval.

Design Speed refers to a nominal speed fixed to determine the geometric feature of a road.

Determining Authority shall refer to either **Council** and/or a **Public Authority**.

Documents refers to all Specifications, Standards, Drawings and Correspondence which are related to the works and referred to by Council or issued by Council.

DPI refers to the NSW Department of Infrastructure and Planning.

Engineering Plans refers to plans associated with Construction Certificates issued by Council or the Certifying Authority under the EP&A Act, and Engineering Approvals issued by Council under the Roads Act (1993) and Local Government Act (1993).

EP&A Act refers to the New South Wales Environmental Planning and Assessment Act 1979 (as amended).

EPA refers to the NSW Environmental Protection Authority.

ESCP refers to an Erosion and Sediment Control Plan.

Excavation refers to excavation in all classes of materials and shall include the removal of loose earth, sand, clay, all growth, shale, igneous, metamorphic and sedimentary rock, ironstone, concrete, masonry, pipes and conduits.

Flow path refers to the overland or underground path, from the highest point to the lowest point, by which rainwater that is not absorbed into the soil during a storm event flows toward receiving waters.

Freeboard refers to the water depth used in relation to the setting of floor levels and the like, to allow for wave action, localised hydraulic behaviour and system blockages.

LGA refers to Local Government Area.

MGA refers to Map Grid of Australia and is the coordinate system to be used for all coordinates on plans.

NATA refers to the National Association of Accredited Testing Authorities.

NPER refers to the National Professional Engineers Register.

NSW SOC refers to the NSW Streets Opening Conference.

OEH refers to the NSW Office of Environment and Heritage.

OSD refers to On-site Stormwater Detention.

Owner refers to the property owner at the time.

Principal Certifying Authority (PCA) refers to an entity either being a consent authority, the Council or an accredited certifier that with the benefit of a development consent or complying development certificate for development involving building work or subdivision work may make various certificates under the EP&A Act for a development.

Probable Maximum Flood (PMF) refers to the largest flood that could conceivably occur at a particular location as a result of the PMP.

Probable Maximum Precipitation (PMP) refers to the greatest depth of precipitation meteorologically possible for a given duration for a given size storm area at a particular location at a particular time of year.

PSD refers to maximum Permissible Site Discharge.

RCP refers to Reinforced Concrete Pipe.

Restriction-As-To-User (RATU) refers to the restriction on use of lands that can be incorporated in an instrument under Section 88B of the Conveyancing Act 1919 (as amended).

Road Authority refers to either **Camden Council**, **RMS** or a **specified Public Authority** as defined under the Roads Act 1993.

RL refers to the reduced level in relation to the Australian Height Datum.

RMS refers to the NSW Roads & Maritime Services.

Section 149 Certificates or S149 Certificates refer to Clause 279 of the Environment Planning and Assessment Regulation 2000 which prescribes the matters to be specified in a planning certificate under Section 149(2) and (5) of the EP&A Act.

SI refers to International System of units and are the units to be used for all purposes.

Site refers to the area of land being developed or the works undertaken as per the application.

Specification refers to this document.

Superintendent refers to an entity or person appointed by the applicant, owner or Council to coordinate and be responsible for the Construction Works and contractors. The superintendent is also defined as the Principal Contractor under the EP&A and may also be the Council.

Supervisor is either the superintendent or a representative thereof that is on-site at all times and liaises between the superintendent, contractors and Council.

Surveyor refers to a consultant that shall be a Registered Surveyor.

UPVC refers to an unplasticised polyvinyl chloride.

WAE refers to the Works as Executed Plan.

WH&S refers to requirements under the Work Health and Safety Act 2011 (as amended).

Works refers to the development of land as described by the Drawings and Specifications (the documents) as proposed by the applicant and as cited and approved by Council in a Construction Certificate including all the area of the land being developed.

WSUD refers to Water Sensitive Urban Design.

SECTION 1 – INTRODUCTION

1.1 PREAMBLE

This **Engineering Design Specification** ('Specification') has been prepared for the guidance of owners, applicants, superintendents, consultants, contractors and representatives thereof to outline Council's engineering specifications for the design of subdivisions and the development of land within the Camden Council Local Government Area (LGA).

The adoption of specifications for design and construction are necessary so that Council may meet its obligation, in ensuring a uniform standard of development, which is an asset to the community.

This Specification has been prepared in order to facilitate the expeditious processing of Engineering Plan submissions for subdivisions and developments.

The standards outlined herein are intended to be a minimum standard. The consultants shall be responsible for ensuring that all works generally comply with the specifications and /or other technical directions pertaining to the design. Where situations/circumstances dictate good sound engineering practices which are higher than those specified herewith the consultant shall incorporate these into the design. Generally no departures shall be permitted, however when a departure is identified the consultant shall ensure that the design presented, is based on professional experience, established engineering practice, is safe and fit for purpose, and such alternatives will be considered by Council on their merits

The distribution of this Specification does not imply limitations in any way of Council's rights to impose differing conditions when approving subdivision or development applications, nor limit the Council Engineer's discretion to vary, as considered necessary, the engineering requirements in respect of a particular subdivision or development having regard to the site context.

Council's **Engineering Construction Specification** compliments this Specification and shall be referred to for all construction detail requirements.

1.1.1 Inconsistencies

To the extent that any inconsistencies exist between this specification and the relevant Development Control Plans (DCPs) adopted by Camden Council, the **relevant DCP(s) shall prevail**.

If there are any differences in practice between the RMS supplements and other RMS complementary material, **the RMS supplements will apply**.

1.2 DEVELOPMENT CONTROL AND CONDITIONS

The requirements of the following Acts and Plans apply:

(a) EP&A Act 1979 (as amended);

(b) Local Government Act 1993 (as amended);

(c) Roads Act 1993 (as amended);

(d) Camden Local Environment Plan (LEP); and

(e) Camden DCP(s).

owners/applicants are advised to consult with Council's Planning and Environmental Services section when preparing development plans for the following:

(a) Large subdivisions and developments in areas not covered by a DCP; and

(b) Smaller subdivisions and developments covered by a DCP.

The conditions for development will be established with the development application Conditions of Consent and the associated engineering design and construction requirements will be based on this Specification. Where there is no reference in this Specification to specific design/construction details required for a development, the **Council Engineer** will determine the appropriate requirements.

The applicant is advised to ensure that all relevant conditions of the Development Consent are addressed within the detailed Engineering Plans.

Any proposed changes to the Development Consent issued under the EP&A Act 1979 must have a Section 96 Application lodged with Council for determination.

1.3 ENGINEERING PLANS AND CERTIFYING AUTHORITIES

In this Specification, whenever the term 'Engineering Plan' is used, it shall be deemed to refer to plans associated with Construction Certificates issued by Council or a Certifying Authority under the EP&A Act, and Engineering Approvals issued by Council under the Roads Act 1993 and Local Government Act 1993.

A Certifying Authority may issue Construction and Compliance Certificates for Subdivision and Development Works in accordance with the requirements of the EP&A Act. Therefore any reference made in this Specification to approvals by Council for works under the EP&A Act shall also be deemed to be a reference to certificates issued by a Certifying Authority under the EP&A Act.

Certifying Authorities do not have the authority to issue approvals for proposed work on existing public roads under the EP&A Act and the Roads Act 1993.

1.4 AMENDMENTS TO STANDARDS

This Specification will be reviewed from time to time and it is the applicant's responsibility to ascertain from Council any amendments which may apply.

Amendments to standards contained within this specification made prior to the approval of design plans, will apply to such plans. In the event of a specification change, designers will be provided with a one month grace period, within which designs lodged to Council will be assessed in accordance with the standards in place at the time of the design being carried out.

1.5 CORRESPONDENCE

All correspondence relating to the technical aspects of the development or subdivision is to be directed to the owner/applicant.

Council will hold the owner/applicant of the land for which the development or subdivision approval was issued, solely responsible for constructing all works to the satisfaction of the **Council Engineer** and the maintenance thereof during the specified period.

1.6 SUPERINTENDENTS/CONTRACTORS

Prior to commencement of any works, the name of the superintendent/contractor who is to carry out the work associated with the Subdivision and/or Development Works shall be nominated in writing. Details of experience and technical expertise in similar works, and insurance details are also required.

Details for superintendents/contractors approved by Council within the preceding year will not be

required.

1.7 INSURANCE

1.7.1 Public Liability Insurance

The applicant must ensure that superintendents/contractors engaged on Subdivision, Development Works (under the EP&A Act) or Road Works (under the Roads Act 1993) have a current Public Liability Insurance Policy to the value of at least **$20 million** unless otherwise specified by Council.

The policy shall specifically indemnify Council from all claims arising from the execution of works.

1.7.2 Workers Compensation

The employer must ensure that superintendents/contractors engaged on Subdivision and Development Works (under the EP&A Act) or Road Works (under the Roads Act) have current Workers Compensation Insurance Policies for all employees as required by Statute.

1.7.3 Professional Indemnity Insurance

The applicant must ensure that the all consultants engaged on Subdivision and Development Works (under the EP&A Act) or Road Works (under the Roads Act) have the appropriate level of Professional Indemnity Insurance. Prior to the issue of the Construction Certificate or Roads Act Approval, the owner/applicant must submit proof of Professional Indemnity Insurance to Council for the whole of the works.

For private roadworks being undertaken within private property in accordance with the EP&A Act, Council must be provided with proof of Professional Indemnity Insurance.

1.8 SUBMISSION REQUIREMENTS

Engineering design for Subdivisions and Development Works requires specialist knowledge and Council must be satisfied with the competence and availability of the consultants.

Council requires that design plans to Council's specifications be prepared by a suitably experienced person and certified on the plans, by a suitably qualified person, or approved by the **Council Engineer** and/or who has proven experience in the preparation of plans and specifications for land development.

After the applicant has received notification of development application approval, and if such approval includes conditions requiring the carrying out of any work such as the construction of roads, the building of drains, culverts, bridges and the like, the requisite number of Engineering Plans and specifications adequately describing the same in accordance with the standards and principles defined in this Specification and Council's **Engineering Construction Specification** shall be first submitted along with an appropriate application and payment of fees to obtain a Construction Certificate before any such work is commenced.

The lodgement of complete submissions at the appropriate time will assist in the efficient processing and approval of such submissions. Consultants are advised to fully address the peculiarities of each site and the impact on adjoining land to ensure that proposed construction works are acceptable in terms of safety and operational effectiveness.

Initially one A3 and an electronic copy of the Engineering Plans with the relevant stormwater data plus the Construction Certificate application and the relevant fee/s shall be forwarded to Council for approval.

If the plans require amendment, Council will return the plans for amendment. One A3, an electronic

copy as well as Council's 'marked up' plans should then be forwarded to Council and so on until the plans are approved. It should be noted that an additional Construction Certificate fee shall apply for checking of subsequent amended Engineering Plans. Part (a) above will then apply.

1.8.1 Plans

Plan size, lettering, line work and symbols are to conform to the relevant part of **AS1100.101** and **AS1100.401**.

All Plans submitted for approval shall be provided using SI units and all levels shown shall be to the **Australian Height Datum (AHD)**.

1.8.2 Scales

Scales of all plans are to be shown by bar scales as follows:

(a) Engineering Detail Plan - 1:1000, 1:500 or 1:200;

(b) Road Longitudinal Section - 1:100 (vertical) to 1:500 (horizontal);

(c) Road Cross Section - 1:100 Natural or 1:100 (vertical) to 1:200 (horizontal);

(d) Intersection Details - 1:250, 1:200 or 1:100;

(e) Layout Plan - 1:500, 1:1000, 1:2000 or 1:4000;

(f) Catchment Plan - 1:500, 1:1000, 1:2000 or 1:4000 (for external catchments);

(g) Locality Plan - 1:500, 1:1000, 1:2000 or 1:4000;

(h) Kerb Return Plan - 1:200;

(i) Kerb Return Longitudinal Section - 1:100 (vertical) to 1:200 (horizontal); and

(j) Details - 1:10, 1:20, 1:50 or 1:100 as required.

1.8.3 Drawing Title

All sheets must show the following information in the title block:

(a) Development Consent number;

(b) Property Description;

(c) Owner/applicant;

(d) Surveyor/Engineer;

(e) Scale and Datum;

(f) Plan Number and Sheet Number;

(g) Description of Work on Sheets; and

(h) Amendment/revision number and description.

1.8.4 Drawing Details

The following items shall be detailed in the drawings, and the layout of each shall be on a separate sheet unless otherwise approved by the **Council Engineer**:

(a) A Cover Sheet with a suitable Locality Plan and List of Final Drawings;

(b) General Layout Plan;

(c) General Notes

(d) Roads and Kerb and Gutter;

(e) Drainage;

(f) Water Quality facilities;

(g) Site Regrading and/or filling including contour information;

(h) Landscaping Plan;

(i) Erosion and Sediment Control Plan or Soil and Water Management Plan;

(j) Traffic Control Plan (if required);

(k) Traffic Management Plan (if required);

(l) Parking Plan (if required);

(m) Structural Plans, e.g. Pits (if required);

(n) Other Structures, e.g. Dams (if required); and

(o) Identified Extent of Flooding (if applicable).

A north point is to be provided on each drawing to indicate the orientation of the plans.

All drawings shall be signed by the respective Design Consultant engaged by the owner/applicant.

1.8.5 Approval of Engineering Plans

Engineering Plans will be checked by Council or a Certifying Authority for compliance with Camden Council's **Engineering Design Specification.** This does not imply that all calculations and designs will be scrutinised. It is the entire responsibility of the owner/applicant submitting the documents, to ensure that the designs comply with the following:

(a) Development Consent;

(b) Council's **Engineering Design Specification**;

(c) Council's **Engineering Construction Specification**;

(d) Relevant Australian Standards (current);

(e) Relevant Local, State and Federal Government Legislation; and

(f) **Current engineering best practice**.

Construction and Compliance Certificates for Subdivision and Development Works are to be issued by Council or a Certifying Authority in accordance with the EP&A Act 1979.

Engineering approvals from Council for all Subdivision and Development Works on or adjacent public roads must be issued in accordance with the Roads Act 1993. As part of these Works the RMS may have provided conditions to be included in the DA consent. If so, RMS concurrence/approval of the design must be provided to Council prior to issue of a Construction Certificate.

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

If work has not commenced prior to the lapsing of the development Consent, the Development Application and associated Construction Certificate is void and an additional Application and revised Engineering Plans must be submitted with the appropriate fees for approval.

1.8.6 Standard Notes

The standard notes provided below shall be included on the Engineering Plans as a minimum:

GENERAL NOTES

G1 All work to be carried out in accordance with Camden Council's **Engineering Design Specifications** (this document) and **Engineering Construction Specifications** and to the requirements of the Principal Certifying Authority.

G2 Inspections by Certifying Authority are required at the following stages and the works approved prior to continuance of any future work:

(a) Following installation of erosion and sediment control structures/measures;

(b) Prior to backfilling pipelines, subsoil drains and dams;

(c) Prior to casting of pits and other concrete structures, including kerb and gutter but following placement of footings, formwork, and reinforcement;

(d) Prior to placement of sub base and all subsequent pavement layers, a proof roller test of each pavement layer is required;

(e) Formworks prior to pouring concrete in parking area for footpath crossing and other associated work;

(f) Prior to backfilling public utility crossings in road reserves; and

(g) Final inspections after all works are completed and 'works as executed' plans have been submitted to Council.

G3 No trees are to be removed unless approval is granted by Council's Landscape Compliance Officer or as authorised by development consent.

G4 Make smooth junctions with existing works.

G5 No work is to be carried out on Council property or adjoining properties without the written permission from the owner/s.

G6 Vehicular access and all utilities/services are to be maintained at all times to adjoining properties affected by construction.

G7 All rubbish, buildings, sheds and fences to be removed to satisfaction of **Council's Engineer**.

G8 **Council Engineers** have discretion to vary, as considered necessary, the engineering requirements in respect of a particular subdivision or development having regard to the site context.

EARTHWORKS NOTES

E1 Earthworks are to be carried out to the satisfaction of the Council. Unsuitable materials are to be removed from roads and lots prior to filling. The contractor is to arrange and make available compaction testing results for all areas that contain fill in excess of 200 mm.

E2 Compaction of earthworks shall continue until a dry density ratio of 95% for site filling and 100% for road pavement subgrades has been achieved in accordance with test method **AS 1289.5.3.1** or **AS 1289.5.1.1** . The control testing of earthworks shall be in accordance with the guidelines in **AS 3798**. Where it is proposed to use test method **AS 1289.5.8.1** to determine the field density, a sand replacement method shall be used to confirm the results.

E3 A suitably qualified Geotechnical Engineer, shall have a level 1 responsibility for all filling as defined in **AS 3798**, and at the end of the works shall confirm the earthworks comply with the requirements of the specification and drawings by written notification.

E4 In areas to be filled where the slope of the natural surface exceeds 1(V):4(H), benches are to be cut to prevent slipping of the placed fill material as required by the Council.

E5 All batters are to be scarified to a depth of 50 mm to assist with adhesion of top soil to batter face.

E6 Provide minimum 150 mm and maximum 300 mm topsoil on footpaths, filled areas and all other areas disturbed during construction. Topsoiled areas to be stabilised with approved vegetation a maximum of 14 days after topsoiling and are to be watered to ensure

germination.

E7 The contractor shall control sedimentation, erosion and pollution during construction in accordance with the requirements of '**Managing Urban Stormwater - Soils and Construction'** produced by Landcom. Measures must be reviewed for suitability and maintained throughout the life of the project.

E8 A minimum 1 metre wide, continuous strip of couch grass shall be placed behind the back of all kerbs and other concrete structures immediately after the completion of the footpath grading or other elements as applicable, and shall be maintained and replaced as required during the construction maintenance period.

ROADWORKS NOTES

R1 Subgrades and sub bases are to be compacted in accordance with Council's Construction Specification. Density tests and confirmation that the results have satisfied the requirements of the engineering specification must be provided to Council and approval obtained prior to the next layer being installed.

R2 Subsoil drains to be provided on both sides of roads (except where there is stormwater drainage).

R3 150 x 50 H.D. galvanised steel kerb outlets to be placed in all kerb types on low side of lots. The outlet is to continue across footway to 300mm within the property boundary, an elbow shall be installed to bring the pipe to the surface and the pipe end capped to prevent entry of foreign material.

R4 Lipless perambulator crossings are to be provided in all kerb returns and where required by Council.

R5 Service conduits to be placed as directed by all public utility authorities including but not limited to Endeavour Energy, Telstra and Sydney Water

R6 Proposed utilities and services crossing existing roads shall be provided for using a trenchless technique so as not to damage the existing surface. All service conduits under roads must be laid to a minimum depth of 750 mm.

R8 All temporary roads must be temporarily sealed with a single coat flush seal.

R9 All permanent roads must be sealed in accordance with the approved drawings.

R10 Signposting and line marking shall conform to **AS 1742.2**, '**RTA Supplement to Australian Standards 1742'**, the '**RTA Delineation'** Guidelines and **RMS Signs Database**. Raised retro-reflective pavement markers to conform to **AS/NZS 1906.1** and **AS 1906.3** are to be provided. All aprons and kerb face on central islands of roundabouts and all other islands to be delineated by reflective white marking.

R11 All lot numbers and street names must be stencilled on kerb face.

R12 Street signs to Council standard must be installed by the contractor.

STORMWATER NOTES

S1 All pipes to be spigot and socket, rubber ring jointed.

S2 All longitudinal pipelines in roads must be located under kerb and gutter and be backfilled with approved granular material unless otherwise approved by the **Council Engineer**.

S3 Drainage lines must be backfilled with approved granular material in trafficable areas. Three (3) metres of subsoil drainage wrapped in geotextile stocking must be provided to all downstream pits.

S4 All gully pits to Council's standard and lintels centrally placed at sag pits.

S5 All pits must be benched and streamlined. Reinforcement and galvanised step irons must be

provided to all pits over 1.2 metres deep as measured from the top of kerb to the invert of the pit.

S6 Concrete is to have minimum compressive strength of 32MPa at 28 days unless otherwise approved by the **Council Engineer**.

S7 All interallotment drainage must have a minimum pipe diameter of 150 mm and a minimum grade of 1% unless otherwise approved by the **Council Engineer**.

S8 All interallotment drainage lines must be laid centrally within drainage easements. Inspection pits must be provided for each lot and at all changes of grade and direction.

S9 Interallotment drainage lines must be installed after Sydney Water sewerage lines have been installed where sewer is proposed adjacent to interallotment drainage lines.

S10 1% AEP overland flow paths must be formed and shown on 'works as executed' drawings.

S11 All plans (both design and WAE) are to clearly delineate the extent/location of flood lines including the 5% AEP, 1% AEP and PMF, where the PMF has been determined.

S12 Adequate provision is to be made to prevent scouring and sedimentation for all drainage works in accordance with Council's requirements.

S13 Pit Lintels are to be stencilled with applicable distinction stencil available from Council.

S14 Catch drains must be constructed as required by the approved plans or the Principal Certifying Authority.

S15 Soil and Water Management Plans are to be prepared for all disturbed sites and adhered to at all times during the construction and maintenance periods. Plans must address and make provision for the dynamic nature of the site for each stage of the development.

EROSION AND SEDIMENT CONTROL NOTES

SC1. All erosion and sediment control measures are to be installed and maintained in accordance with Landcom's '**Managing Urban Stormwater - Soils and Construction**'.

SC2. All erosion and sediment control measures shall be implemented prior to the commencement of any work being carried out. All measures shall be maintained and kept in place for the duration of the works and may only be removed upon final stabilisation of the site.

SC3. All erosion and sediment control measures shall be constructed and maintained as indicated on the approved drawings. The actual location and extent of soil and water management devices shall be confirmed on site prior to commencement.

SC4. The contractor shall be solely responsible for the control of erosion and sedimentation to the satisfaction of Council and shall inform all subcontractors and all employees of their responsibilities with regards erosion and sediment control.

SC5. The contractor shall regularly maintain all erosion and sediment control measures to the satisfaction of the superintendent and Council. Repairs and maintenance shall be undertaken as required, particularly after storm events.

SC6. A self auditing program shall be established based on a check sheet developed for the site. A site inspection using the check sheet shall be made by the **Site Supervisor** at least weekly, immediately before site closure, and immediately following rainfall events greater than 5 mm in 24 hours.

SC7. Site access shall only be achieved via a truck shaker at the designated access point as shown on the approved plans. The truck shaker is to be regularly maintained to ensure effectiveness.

SC8. Dust control measures shall be implemented continuously during construction works. Such measures are to be to the satisfaction of the superintendent and Council.

SC9. The areas over stormwater and sewer lines and electricity, telephone and gas supply trenches are to be seeded and mulched as soon as possible but no later than within 14 days after backfill.

SC10. No more than 150 metres of trench is to be open at any one time.

SC11. Stockpiles shall be in low mounds no more than 2 metres high and not located within 5 metres of hazard areas, including likely areas of concentrated or high velocity flows.

SC12. The contractor shall stabilise all stockpiles and disturbed areas, by hydroseeding or as directed by the superintendent or Council, as soon as they are formed to final levels. All seeded areas shall be watered at least twice weekly until grass cover is established.

SC13. All temporary earth berms, diversion and sediment basin embankments are to be track rolled, seeded or mulched for temporary vegetation cover as soon as they have been formed;

SC14 All fills are to be left with a windrow at least 200 mm high at the top of the slope at the end of each day's earthworks, and all earthwork areas shall be rolled each evening to "seal" the earthworks;

SC15. Stabilisation of all cut and fill slopes shall be commenced within 14 days of completion of formation;

SC16. Upon completion of final earthworks or after written direction of Council, immediate silt conservation treatments shall be applied so as to render areas that have been disturbed, erosion proof within 14 days;

SC17. All erosion and sediment control measures affected by works shall be re-established prior to the completion of each day's work.

SC18. All topsoil is to be stockpiled on site for re-use (away from trees and drainage lines). Measures shall be applied to prevent erosion of the stockpiles;

SC19. A strip of turf is to be placed immediately behind the kerb and gutter on all new roads and at additional locations as determined by the **Council Engineer**;

SC20. Topsoil shall be re-spread on disturbed areas as required and stabilised as soon as possible and within 14 days of disturbance. All disturbed areas shall be left scarified to encourage water infiltration and assist with keying of topsoil.

SC21. Sediment basins shall be maintained for the entire duration of the project or until such time as all disturbed areas are stabilised.

SC22. Any basins to be de-silted shall be flocculated to settle any suspended solids. Upon approval from Council, clear water shall then be pumped out in a manner that will not cause downstream erosion. When dry, the silt shall be mixed with topsoil for future spreading or removed from site.

SC23. The contractor shall maintain a logbook detailing:

(a) Records of all rainfall;

(b) Daily condition of all erosion and sediment control measures;

(c) Any application of flocculation agents to sediment basins;

(d) Method and volume of water discharged from basins; and

(e) Any additional remedial works required.

The logbook shall be made available to any authorised person upon request and issued to the project manager upon completion of works.

SC24. All final erosion prevention measures, including establishment of grassing, are to be completed prior to the subdivisions final inspection.

SECTION 2 – ROAD DESIGN

2.1 GENERAL

This section of the specification provides for the design of both public carriageways and footpaths within road reserves and private roads, rights of carriageway and battle axe roads within private land in the Camden Council LGA. It is in no way a comprehensive design specification and it is intended to be read in conjunction with the following references:

(a) **AUSTROADS** Guidelines;

(b) **RMS AUSTROADS Supplements**;

(c) ARRB Transport Research 'Sealed Local Roads Manual – Guidelines to Good Practice for the Construction, Maintenance and Rehabilitation of Pavements';

(d) Austroads Guide to Road Design (2009);

(e) NSW Rural Fire Service **'Planning for Bushfire Protection (2006)'**;

(f) Relevant Australian Standards; and

(g) Relevant DCPs adopted by Council.

Design of the road hierarchy network shall conform to the requirements of the relevant DCP.

A fundamental requirement of the design process is for designers to determine the vehicle speed which is deemed acceptable for a particular subdivision or section of road. The concept of designing to regulatory street speeds is contrary to the current principles of subdivision road design.

All relevant design principles must be integrated in the development of the road network. A careful balance is required between maximising amenity, safety and convenience considerations and those related to the drivers' perception of driving practice.

When considering road crossings of riparian areas, reference should be made to the '**Fish friendly waterway crossings Policy and guidelines'** and '**Policy and Guidelines for fish habitat conservation and Management'**.

2.1.1 Objectives

The following objectives shall be reflected in the road design:

(a) Efficiency in maintaining movements of vehicles including buses, services and emergency vehicles;

(b) Safety for drivers, pedestrians, cyclists and others who enjoy the use of the road, and protection of adjoining property;

(c) Public safety from a criminal standpoint considering the NSW Police **'Safer by Design'** or **Crime Prevention through Environmental Design principles and protocols**;

(d) Minimisation of construction and maintenance costs and avoiding the need for future property acquisition;

(e) Protecting the environment by minimising visual impact and assuring high-speed and through traffic is directed out of residential areas;

(f) Maintain flexibility to allow for future change in use land patterns;

(g) To ensure that noise from all sources is within acceptable limits; and

(h) To ensure a high level of amenity and safety.

2.2 DETAILED ROAD DRAWINGS

2.2.1 Layout Plans

These plans shall be drawn to an appropriate scale as provided in **Section 1.8.2** and will illustrate:

(a) Boundaries of road reserves, pathways, public reserves, lots, lot numbers and easements both existing and proposed in relation to road chainages;

(b) Public Road, Private Road and Pathway numbers or names;

(c) Existing contours, spot levels and final surface contours (min interval 0.5 metre) to AHD;

(d) State Survey Marks including Northing and Easting coordinates in MGA format, with ties to existing boundaries and Bench Marks to AHD;

(e) Existing natural features such as cliffs, watercourses, swamps, dams, ditches;

(f) Existing constructed features including building structures, retaining walls, fences, kerb & gutter, road pavement, pipe, pits, existing wastewater facilities and adjacent subdivisions;

(g) Limits of work;

(h) Road chainage pegs and other survey lines and sections;

(i) Schedule of symbols and notation of items e.g. kerb and gutter, gully pits, pipelines;

(j) Kerb and gutter alignment and concrete path paving;

(k) Existing and proposed drainage lines and structures suitably numbered and location chainages. Identified extent of flooding (if applicable);

(l) Proposed fencing details;

(m) Details and schedule of subsoil drainage lines;

(n) Notation regarding provision of guide posts and guard rails;

(o) Road centreline bearing radii and chainages, kerb return and cul-de-sac kerb alignment radii and chainages;

(p) Show any centreline line marking of a road

(q) Tangent points to curves;

(r) The location and level of all existing utility services including pits, poles and structures with construction notes relating to any necessary alterations;

(s) Pavement requirements, surfacing requirements, lead in and tail out works, pipe types and classes, drainage structure types, kerb types, concrete strengths, pipe bedding types;

(t) Footpath and carriageway widths;

(u) Road Furniture e.g. street, speed, warning and regulatory signs, guideposts, street lighting;

(v) Site regrading areas indicated by shading;

(w) Extent of cut and fill batters of significance;

(x) Significant trees with trunk diameters greater than 100 mm measured 1 metres above the ground;

(y) Location of bus stop construction;

(z) Kerb return numbers;

(aa) Proposed utility and service crossings;

(bb) Location of parking bays;

(cc) Location of garbage bin pads; and

(dd) North point.

2.2.2 Longitudinal Section

The longitudinal section of the centreline of all roads shall be drawn at scale of 1:500 horizontal and 1:100 vertical and will illustrate:

(a) Chainages running left to right across the page;

(b) Reduced level of existing surface;

(c) Design levels of road centre lines;

(d) Design grades and length of vertical curves;

(e) Chainage and RL of each intersection point;

(f) Chainage and RL at Intersection with other roads;

(g) The chainage and level of each crest and sag point;

(h) Position and levels of culverts, drainage lines and public utility mains;

(i) Work as executed row;

(j) Limits of construction; and

(k) Proposed road name and number.

Longitudinal levels shall be taken at a maximum of 15 metre intervals and at all intermediate changes of grade.

Longitudinal sections shall not be terminated at the extent of works but shall be levelled a distance of 15 metres or as required beyond the limit of works to show transitions to existing road levels.

Where construction and/or reconstruction adjoins an existing road, the longitudinal section shall extend for at least 100 metres beyond the proposed extent of works or as required to reasonably assess smooth transition.

2.2.3 Road Cross Sections

Cross sections shall be drawn at an appropriate scale as provided in **Section 1.8.2** and be provided at a maximum of 15 metre intervals. In addition cross sections shall be drawn at sag points, kerb tangent points and transition points.

For Rural roads, cross sections shall be supplied as above and at all culvert sites and at the transition points around super elevated curves if applicable. Rural road cross-sections shall be defined at 10 metre chainages for curves under a radius of 1000 metres.

Where construction and/or reconstruction adjoins an existing road, the cross-sections shall extend for at least 100 metres beyond the proposed extent of works or as required to reasonably assess smooth transition

Cross sections shall illustrate:

(a) Road centreline chainage below each section;

(b) Offset chainage from the pegged centreline;

(c) Reduced levels of existing surface;

(d) Design levels of pavement, top of kerb, invert and lip of gutters and at concrete paths;

(e) The position, size and level of any existing public utility, mains, cables and services affecting the work;

(f) Existing and proposed road reserve boundaries including adjacent property boundary alignments;

(g) Work as executed row; and

(h) Proposed road name and number.

A typical cross section is to be included at a scale of 1:100 vertical, 1:200 horizontal. Typical road cross sections are to be provided for each road as additional detail on at least one cross section on each sheet of cross sections or alternatively, may be provided separately as a set of typical cross sections. The additional detail for a typical road cross section will illustrate the following:

(a) Footway and carriageway widths;

(b) Crossfalls;

(c) Pegged centrelines;

(d) Kerb type;

(e) Kerb line;

(f) Boundary line;

(g) Typical batter slopes for cut and fill with batter slopes to have a maximum slope of 1(V):4(H);

(h) Differences in levels offsets, relative to the centreline;

(i) Type of surfacing;

(j) Subsoil drainage; and

(k) Footpath location and standard if required.

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

2.2.4 Intersection, Cul-De-Sac and Turning Head Plans.

A contour plan at an appropriate scale as provided in **Section 1.8.2** and must be drawn showing the finished level at all intersections, cul-de-sacs and turning heads.

All intersections shall have two way crossfall.

Each plan shall include the following:

(a) Reference points corresponding with points shown on the kerb return profile;

(b) Contours at minimum 0.1 metre interval;

(c) Kerb return and centreline chainages;

(d) Radii of kerb returns;

(e) Kerb return numbers if applicable (not to be shown on a separate kerb return plan);

(f) Tangent points identified by chainage; and

(g) Location of drainage pits and other structures.

2.2.5 Kerb Return Longitudinal Sections

The design of kerb returns is necessary at all road junctions to ensure a smooth trafficable surface around the return and where necessary to locate low points for drainage purposes.

Kerb return longitudinal sections shall be drawn at an appropriate scale as provided in **Section 1.8.2** for all kerb returns and cul-de-sac bulbs.

Each kerb return longitudinal sections shall have a kerb return number corresponding with a number

shown on the plan view.

The profile shall represent the view as looking from the road to the face of the kerb. The kerb return profile shall show:

(a) Chainages – both the running chainage related to the profile together with the chainage related to the road centreline;

(b) Design kerb lip RL – with a minimum grade of 1%;

(c) Existing kerb lip RL;

(d) Gradings and vertical curves;

(e) Sags and crests;

(f) 15 metre tail out works showing transition in and out of kerb return;

(g) The applicable road name and number leading into the profile;

(h) Instantaneous grade at beginning and end of kerb return profile if applicable; and

(i) Work as executed row.

2.2.6 Kerb Return Plan View

Each kerb return must have a plan view drawn at 1:200. The plan must have, but not limited to the following:

(a) Kerb return numbers;

(b) Contours at maximum 0.1 metre spacing;

(c) All proposed drainage lines and structures;

(d) Reference points corresponding to long sections;

(e) Lip lines;

(f) Maximum depth of ponding at sag points limited to 150 mm;

(g) Two-way crossfall 2% minimum, 4% maximum;

(h) Minimum kerb return radius of 7.5 metres, to the face of the kerb; and

2.3 PLANNING STANDARDS

2.3.1 Road Network Design Characteristics

An overall road hierarchy has been formulated to detail Council's road network design characteristics as they apply to the various types of roads that exist within the Camden Council LGA. The road hierarchy and relevant widths are listed in Table 2.1 of this Specification and are also embodied in Council's DCP. To the extent of any inconsistencies between this Specification and Council's DCP, **the DCP shall prevail**.

New road layouts and widths must conform to that shown in this specification and any other relevant DCPs. The precise location of any proposed roads is subject to the detailed site assessment carried out during the subdivision application process. In areas not covered by a DCP the layout and width will be determined by Council on their merits.

Table 2.1 Camden Council – Subdivision Road Network Design Characteristics

CAT.	ROAD TYPE	CARRIAGEWAY WIDTH	FOOTWAY WIDTH (4)	PATH WIDTH	ROAD RESERVE	KERB TYPE	DESIGN EQUIV. STANDARD AXLES
A	Arterial (State)	As directed by the RMS	As directed by the RMS	2.5m(1) one side	36m	Standard K&G	Based on traffic counts
B(i)	Major Collector Road (i) - Non House Frontage	a) Non-house frontage or access. Divided road 5.0m per direction with 5.0m median.	5.0m Each side	2.5m(1) and 1.5m on other side	25m	Standard K&G	1×10^7
B(ii)	Major Collector Road (ii) – House Frontage	b) House frontage. Divided road 6.5m per direction with 3.0m median.	4.5m Each side	1.5m each side	25m	Standard K&G	1×10^7
C	Collector Road	11m (14m with on road cycle lane)	4.5m each side	1.5m each side	20m (23m with on road cycle lane)	Standard K&G	5×10^6
D	Minor Collector Road	9.0m	3.5m each side	1.2m each side	16.0m	Roll	5×10^5
E	Access Road or Access Place	Connecting road or Cul-de-sac up to 200m - 7.0m	8.0m total inclusive of both sides	1.2m one side	15.0m	Roll	5×10^5 (2)
F	Minor Access Road or Minor Access Place	Short connecting road or Cul-de-sac up to 100m – 4.5m	9.5m total inclusive of both sides	1.2m one side	14.0m	Roll	1×10^5
G	Shareway	Short connecting road up to 40m in length – 3.5m	9.5m total inclusive of both sides	N/A	13.0m	Flush or roll	2×10^4
H	Industrial and Commercial Roads	13.0m	3.6m each side	1.2m one side	20.2m	Standard K&G	5×10^6 (heavy ind. 1×10^7)
I	Rural Collector Road	8.6m	5.7m	1.2m one side	20.0(3)m	N/A	1×10^6
J	Rural Access Road	8.6m	5.7m	1.2m one side	20.0(3)m	N/A	5×10^5

CAT.	ROAD TYPE	CARRIAGEWAY WIDTH	FOOTWAY WIDTH (4)	PATH WIDTH	ROAD RESERVE	KERB TYPE	DESIGN EQUIV. STANDARD AXLES
K	Rural Minor Access Road	8.6m	5.7m	1.2m one side	20.0(3)m	N/A	1×10^5
L	Lanes	6.0m	1.5m	N/A	9.0m	Flush or roll	1×10^5

(**1**) Off-road cycleways or shared bicycle pedestrian ways to be provided.

(**2**) Car park and Private Road pavements shall be designed to accommodate a Design Traffic Loading of 1×10^5.

(**3**) The road reserve width of 20-metres is nominal only and consideration is to be given to the extent of cut and fill batters, catch drains, intersection layout requirements and provision for public utilities adjacent to the road reserve boundary.

(**4**) Where road reserve adjoins another reserve the footway width on that side may be reduced provided all services can be accommodated in accordance with the **'Guide to Codes and Practices for Streets Opening'**.

2.3.2 Half Width Roads

The provision of half road constructions is significantly influenced by site specifics, development staging/layout and funding considerations. To be able to consider any combination of these influences within a single approach in dealing with half road constructions is prohibitive. Therefore Council does not encourage the construction of half width roads as part of subdivisional developments.

In situations where site specifics and development staging/layout necessitate that pavement construction be carried out, the applicant will cover all costs associated with the design of the full road width and construction of half the full width pavement, including adequate transitions to full width cross sections, plus a two way traffic configuration ensuring operational effectiveness and safety to relevant Standards and approval.

Where half road construction is necessitated an AC pavement will be provided to a minimum distance of 1 metre past the road centreline, measured transversely, with a minimum width of 6.0 metres to allow for two way traffic. A full size temporary turning circle must be provided where there are no through roads, to cater for truck turning movements. All turning circles are to be constructed within the subject land.

2.3.3 Dead End / Staged Road Construction

Where roads are constructed in stages of a subdivision, a temporary single coat flush sealed turning area suitable for heavy rigid vehicles and a permanent type barricade shall be constructed at the end of that stage to warn motorists of the dead-end and prevent their passage beyond. Such barricades are only to be removed upon commencement of the adjoining stage.

A turner area must always be provided for garbage vehicles, regardless of the staging.

Generally, the barricades shall be made of guide posts with eye reflectors. The distance between two (2) guide posts shall be less than 2 metres. However, a site assessment is required to determine the adequacy of such measures given the prevailing site conditions.

2.4 GEOMETRIC DESIGN

2.4.1 Principles of Road Design

The following principles pertain to all sites and must be resolved by an appropriate engineering design:

(a) Traffic speeds on any road should be compatible with the residential functions of that road;

(b) The carriageways must provide a smooth, safe trafficable alignment and surface;

(c) Access is to be made available to building allotments across the street footpaths;

(d) Ponding of surface water run-off on the naturally high side of the road reserve is to be alleviated by site filling if practicable, the run-off being catered for in the street drainage system. Alternative drainage schemes shall be designed if ponding is unavoidable;

(e) Provision is to be made for bushfire protection with consideration given to siting and maintenance access; and

(f) Unless there are specific site requirements to excavate material for site filling and improvement works or to provide a stockpile of surplus material for special purposes, excavation shall be kept to a minimum to balance the necessary filling of embankments, in the road reserves and associated batters.

2.4.2 Road Widths

The criteria upon which residential roads are to be designed are provided in Table 2.1. A formal traffic study is required where traffic volumes exceed 3000 vehicles per day. Such a traffic study is to be prepared by a qualified Traffic Engineer in accordance with the RMS and **AUSTROADS** Guidelines. The owner/applicant shall cover all costs associated with the formal traffic study.

Cross sections for both Urban and Rural roads shall be in accordance with **Standard Drawing No.SD01**.

Particular areas in the Camden Council LGA have DCPs with specific road design criteria. Reference will be made to these in discussions with **Council's Engineers**.

2.4.3 Horizontal Alignment

The minimum radius of horizontal curves for all roads shall be in accordance with Table 2.2.

Table 2.2 Minimum Curve Radii

MINIMUM DEFLECTION ANGLE	MINIMUM RADIUS (METRES)
75	20
60	33
40	65
30	75
20	100

Where the deflection angle is 90 degrees and travel speed is not an issue, the size of the horizontal curve is to be related to the turning requirements of a 12.5 metre Heavy Rigid Truck.

The geometric design of Rural roads shall generally be in accordance with the **AUSTROADS Guidelines**.

The design speed to be used for a particular road shall be the legal speed limit for that road. Should conditions so require, the design speed may be increased or lowered to the satisfaction of **Council's Enginee**r. Where it is practicable horizontal and vertical curves should coincide with each other.

2.4.4 Longitudinal Gradient

Longitudinal grades shall generally be in accordance with Table 2.3.

Table 2.3 Minimum/Maximum Longitudinal Grades(1)

ROAD TYPE	MINIMUM	MAXIMUM
Major Collector Roads	1.0%	10.0%
Collector Roads	1.0%	10.0%
Industrial	1.0%	6.0%
All other Urban Residential Roads	1.0%	15.0%
Rural Roads	1.0%	15.0%

(**1**) To occur over a maximum distance of 100 metres on a straight alignment.

At intersections, the maximum crossfall should not exceed 4% with a minimum crossfall of 2%. The maximum longitudinal grade to be used adjacent to street intersections, locations of poor visibility,

horizontal curves of radius 15 metres or less and at cul-de-sacs, should not exceed 10%.

The maximum longitudinal grade within cul-de-sacs turning circles should not exceed 8% (minimum 2%).

For Rural roads where longitudinal grades exceed 6%, appropriate measures shall be detailed to prevent scouring. Where shoulders are sealed, edge line markings are to be provided.

In special circumstances where it is difficult to provide a road location to conform to the required grades, flatter or steeper grades may be permitted over short distances at the discretion of **Council's Engineer**.

2.4.5 Vertical Curves

Vertical curves are to be provided at all changes of grade and where practical coincide with the horizontal curvature. Vertical curves are to generally provide for a stopping sight distance at a design speed of:

(a)	Collector Road	60 km/h;
(b)	Minor Collector Road	60 km/h;
(c)	Access Road	50 km/h;
(d)	Cul-de-sac	30 km/h; and
(e)	Rural Areas	the legal speed limit.

Council will not permit vehicular access to properties where the minimum stopping sight distance is not available.

The design of vertical curves is to be generally in accordance with **AUSTROADS** and **RMS Supplements**.

2.4.6 Carriageway Crossfall and Offset Crown

A crossfall of 3% from a central crown shall be standard. Carriageways shall normally be designed with a central crown.

Offset crowns may be necessary at intersections and cul-de-sac turning circles but should be avoided in streets of uniform width. In such cases the crown of the road may be shifted to a minimum of 2.0 metres from the kerb on the high side of the road.

Where super-elevation of horizontal curves is considered necessary, designs should be based on **AUSTROADS** and **RMS Supplements**. The relative change in grade of kerb line and centreline should not exceed 0.5%.

For Rural roads the following cross falls shall apply:

(a)	Unsealed shoulders	4% ± 1% (max. and min.)
(b)	Table drains	8% (max.).

2.4.7 Pathways

The following resources will assist in the planning and design of cycleways, footpaths and pathways:

(a) **AS 1742.1** 'Manual of Uniform Traffic Control Devices - General Introduction and Index of Signs';

(b) **AS 2890.3** 'Parking Facilities – Bicycle Parking';

(c) **AUSTROADS** Guidelines;

(d) RTA **'NSW Bicycle Guidelines'**;

(e) '**NSW Planning Guidelines for Walking and Cycling'**;

(f) **'Austroads Cycling Aspects of Austroads Guides'**;

(g) NSW Rural Fire Services **'Planning for Bushfire Protection'**;

(h) **Council's Standard Drawing SD01**; and

(i) **RMS Australian Standard Supplements** and **RMS AUSTROADS Supplements**.

Such designs should generally comply with the requirements of the above guidelines and standards with due consideration given to the following:

(a) Location, horizontal and vertical alignment;

(b) Width and crossfall;

(c) Drainage;

(d) Clearance to structures, vertical and lateral generally in accordance with **AUSTROADS** guidelines;

(e) Projections into the cycleway (utility pits etc) are to be avoided;

(f) Maintenance and access crossings;

(g) The provision of tactile indicators in accordance with **AS 1428.4.1** ;

(h) Signposting and pavement marking in accordance with **AS 1742.1** and '**RTA Supplement to Australian Standards 1742**' to provide for the safe and convenient use of the facility;

(i) The provision of adequate railings to bridges or similar structures to limit vehicular access generally in accordance with **AUSTROADS** guidelines, **AUSTROADS 'Guide to Road Design'** and the **RMS AUSTROADS Supplements**; and

(j) The provision of adequate cycleway hand railings at intersections and road crossings generally in accordance with **AUSTROADS** guidelines and the, **AUSTROADS 'Guide to Road Design'** and the **RMS AUSTROADS Supplements**.

Unpaved or partially paved footpaths shall be constructed to a standard crossfall of 4% from top of kerb and shall extend beyond the road reserve boundary for a minimum distance of 0.5 metres. Any associated fill batter or cut face shall be provided within the adjacent lot. In areas where the footway is to be totally paved from top of kerb to the adjacent boundary a 2% crossfall may be used.

2.4.7.1 Footpaths

Footpaths shall be provided generally in accordance with Table 2.1. Notwithstanding the guidelines and reference documents provided in this specification the following should apply when designing footpaths:

(a) Located as indicated in Council's DCPs from the property boundary;

(b) Minimum width of 1.2 metres and a minimum thickness of 100 mm with L72 steel reinforcement;

(c) Maximum crossfall of 4% and a minimum crossfall of 2% towards the road pavement;

(d) Signposting and pavement marking to be provided in accordance with **AS 1742.1** to allow for the safe and convenient use of the facility;

(e) Minimum headroom of 2 metres and minimum formation width of 2 metres;

(f) L72 steel reinforcement is to be provided in footpaths abutting roll-top kerbs;

(g) Hinged joints shall be placed directly opposite any proposed tree and 1.2 metres either side of the tree if the tree is within 1.5 metres of the footpath. Minimum panel length is 1 metre.

For typical section of footpath refer to **Standard Drawing No.SD04** and to **AUSTROADS** guidelines.

As detailed in Table 2.1, footpaths are to be provided on both sides of collector roads and on one side of local bus routes or where required by Council's Planning and Environmental Services. In areas adjoining public reserves, across vehicular crossings and abutting to roll top kerb the minimum thickness shall be increased to 125 mm. Where houses are constructed with the construction of the footpath, this thickened dimension may be applied to the driveway area only.

Additional footpaths will be required in public reserves to complete a footpath system in accordance with a layout to be approved by Council.

Low level and high level footpaths are to be avoided, but where this is impossible, provision must be made for satisfactory vehicular access to each lot in accordance with **AS/NZS 2890.1** .

In areas where footpaths are located adjacent to drainage reserves, reverse crossfall shall be provided at sag points in the road longitudinal section.

Reference should be made to Council's '**Landscape and streetscape Elements Manual'** for footpath colours and finishes.

2.4.7.2 Cycleways and Shared Bicycle / Pedestrian Ways

Cycleways can be provided both on-road and off-road. Where provisions are included within the subdivision for on-road cycleways full design details shall be provided in the Engineering drawings. All on-road cycleway designs shall be undertaken in accordance with the **AUSTROADS** Guidelines.

Where provisions are included within the Subdivision for off-road cycleways or shared bicycle/pedestrian pathways, full design details shall be provided in the Engineering drawings. Off road cycleway and shared way designs shall be undertaken in accordance with the **AUSTROADS** Guidelines and include:

(a) Minimum path width of 2.5 metres and a minimum thickness of 100 mm;

(b) Longitudinal sections at a scale of 1:500 Horizontal and 1:100 Vertical;

(c) Maximum grade of 1:14 and a minimum grade of 1:100;

(d) Maximum crossfall of 4% and a minimum crossfall of 2%;

(e) A typical cross section;

(f) Vehicular barriers to be provided in accordance with **Standard Drawing No.SD05** where required;

(g) Pedestrian hand railings to be provided in accordance with the **AUSTROADS 'Guide to Road Design'** and the **RMS AUSTROADS Supplements** where required (refer to Council's DCP for further information on handrail colours and styles);

(h) Signposting and pavement marking to be provided in accordance with **AS 1742.1**, **RTA Supplement to Australian Standards 1742** and the **AUSTROADS** Guidelines, to allow for the safe and convenient use of the facility;

(i) Approved pictorial direction sign indicating the closest cycleway link to be provided at roadway intersections as required by the **Council Engineer**;

(j) Where required bicycle parking installation to be provided in accordance with the AUSTROADS Guidelines and be fabricated to meet **AS 2890.3** and **RTA Supplement to Australian Standards 1742**;

(k) Minimum headroom of 2.5 metres and minimum formation width of 3 metres; and

(l) Hinged joints shall be placed directly opposite any proposed tree and 1.2 metres either side of the tree if the tree is within 1.5 metres of the cycleways and / or shared bicycle/pedestrian way/s. Minimum panel length is 1 metre.

For typical sections of cycleway and / or shared ways refer to **Standard Drawing No.SD05** and to **AUSTROADS** guidelines.

As outlined in Table 2.1, off-road cycleways or shared bicycle/pedestrian ways are to be considered on one side of sub-arterial and major collector roads or where required by Council. Where provisions are included for off-road cycleways or shared bicycle/pedestrian ways full design details shall be provided in the Engineering drawings.

Fire trails maybe also be used as off-road cycleways or shared bicycle/pedestrian ways. In this scenario the design of the off-road cycleways or shared bicycle/pedestrian ways must be in accordance with requirements of the NSW Rural Fire Service, with the provision of the fire trail to take precedence.

Refer to Council's '**Landscape and streetscape Elements Manual'** for cycleway colours and finishes.

2.4.7.3 Shareways / Accessway

Residential developments may include the provision of shareway / accessway linking roads to facilitate movement towards bus routes, schools, community centres or parks.

Where provisions are included within the Subdivision for shared ways, full design details shall be provided in the Engineering drawings including:

(a) Minimum concrete path width of 1.2 metres and a minimum thickness of 100 mm;

(b) Longitudinal sections at a scale of 1:500 Horizontal and 1:100 Vertical;

(c) Maximum grade of 1(V):14(H) and a minimum grade of 1(V):100(H);

(d) Maximum crossfall of 4% and a minimum crossfall of 2%;

(e) A typical cross section;

(f) Vehicular barriers to be provided at either end of each pathway;

(g) Signposting, pavement marking and pathway rails to be provided in accordance with **AS 1742.1** and **Standard Drawing SD05** and '**RTA Supplement to Australian Standards 1742'**; and

(h) Minimum headroom of 2 metres and minimum formation width of 2 metres.

Shared way systems may be used as catch drains or surface channels to control and convey surface stormwater flow to underground pipe systems so minimising the quantity and concentration of the surface water traversing the areas occupied by dwellings. Shared ways designated as catch drains or surface channels are to generally have a Standard integral 150 mm kerb on the low side and should have sufficient capacity to carry the flows with the required freeboard.

Construction of shared ways should not be undertaken until adjacent houses are built. An incomplete works bond is required to cover these works at linen release.

Reference should be made to Council's '**Landscape and streetscape Elements Manual'** for pathway colours and finishes.

2.4.8 Batters

Standard cut and fill batters are to be designed at stable slopes in accordance with Table 2.4. Batters shall lie wholly within the adjacent allotments commencing 0.5 metres beyond the road reserve boundary.

Table 2.4 Maximum Batter Slopes

BATTER TYPE	DESIRABLE MAXIMUM (V:H)	ABSOLUTE MAXIMUM (V:H)
Earth	1:6	1:4
Rock	1:0.5	1:0.25

The abovementioned slopes for rock batters refer only to cut batters in solid rock with few clay bands.

Where the maximum slopes detailed above cannot be reasonably attained, variances may be permitted subject to approval by **Council's Engineer**. Where variances in slope are approved, provision shall be made to ensure the stability of the batter.

Notwithstanding the above, access to each lot shall be available at natural surface level at the building line with a maximum grade and changes of grade in accordance with **AS/NZS 2890.1** .

2.4.9 Batter Encroachments

Where any cutting or filling required as part of the Subdivision and/or Development Works, whether shown on the plan or not, encroaches on any private or crown property, is retained by an existing structure, or could possibly undermine or remove the support of any existing structure, the owner/applicant shall either:

(a) Take out an easement of support over such a batter in favour of the owner; or

(b) Construct a retaining wall, the design and drawing of which are to be undertaken by a suitably experienced person and certified on the plans by a suitable qualified Structural Engineer and submitted to Council before the commencement of construction.

2.4.10 Road Embankments

Where road embankments exceed 1 metre in height and the batter slope exceeds 1(V):4(H) a safety barrier of a type approved by the Council's Engineer shall be provided.

Safety barriers for roads and road embankments are to be provided generally in accordance with the **AUSTROADS** guidelines.

2.4.11 Intersections

The design of intersections is to be generally in accordance with the **AUSTROADS** guidelines, the **RMS Supplements** and any requirements of Council.

Intersections should generally be located so that streets intersect at right angles with a maximum angle of skew of 20 degrees. Adequate stopping and sight distances should be provided on each of the approach legs of an intersection and for any horizontal or vertical curves.

Notwithstanding the guidelines and reference documents provided in this specification the following should be considered when designing intersections:

(a) Intersections with RMS classified roads are to be designed in accordance with RMS requirements;

(b) RMS approval shall be obtained for designs involving RMS classified roads;

(c) Intersections for all roads are to be designed in accordance with the relevant requirements;

  (i) Major intersections – Intersections of roads shall be designed to meet **AUSTROADS 'Guide to Road Design'** and the **RMS AUSTROADS Supplements** and **AUSTROADS** guidelines.

  (ii) Minor Intersections – Minor intersections shall be assessed with regard to safe traffic usage in accordance with **AUSTROADS** standards addressing sight lines, by-pass potential, and regulatory signposting etc.

  (iii) The minimum inside kerb radius of the sealed edge of the road shall be 9 metres and adequate acceleration/deceleration lanes and passing lanes shall be provided at the intersection.

  (iv) All underground and above ground utilities and services shall be relocated not to interfere with any roadwork's, movement or driver sight distance;

(d) Council approval shall be obtained for all designs within an existing public road in accordance with the Roads Act 1993;

(e) The minimum crossfall is 2% while the maximum crossfall is 5%;

(f) At each road junction the major road shall be designed first, the crossfall of the through carriageway being maintained at the standard 3% from the crown to the gutter lip alignment. The minor road is to be graded to conform with the levels of the gutter line of the major road;

(g) "T" junctions shall be adopted in preference to four way intersections and should take it into account horizontal and vertical alignments at the proposed site and future roadway capacity requirements. The absolute minimum sight stopping distance for the design speed of roads (as described in AMCORD) shall be taken as the minimum distance allowable between "T" junctions;

(h) Where intersections are in a configuration deemed likely to cause traffic problems, traffic islands should be considered for traffic control and safety;

(i) So that drivers will see approaching traffic, there shall be an area of sight unobstructed by buildings or other objects across the corner of an intersection. Additional earthworks shall be considered at the splay corners to alleviate any restriction in sight distance;

(j) Taper lanes 3.5 metres wide may be required for traffic generating developments.

2.4.12 Cul-De-Sac Heads

The longitudinal profile of the kerb and gutter of the cul-de-sac head shall be based on the adoption, as far as practicable, of the standard 3% carriageway crossfall at critical points in the arc length with easing changes in grade by designed vertical curves as required.

The minimum acceptable crossfall is 2% while the maximum allowable crossfall is 8%.

Off-centre cul-de-sac heads shall be designed by offsetting the road carriageway crown to create symmetrical conditions with the kerb return longitudinal profile being designed accordingly.

The minimum kerb/edge of seal line radius in cul-de-sac shall be 9.2 metres in Urban and Rural areas, and 13 metres in Industrial and Commercial areas.

It will be necessary to give special consideration to the design of kerb longitudinal profiles for cul-de-sacs which drain to the head. In these cases provision is to be made to take drainage from down hill cul-de-sacs via pipelines through easements, pathways or drainage reserves. It is essential that an overland flow path also be provided for events which exceed pipeline capacity or to allow for blockages of the downstream line.

The location of overland flow path may not be flexible and regrading may be necessary to ensure safe overland flow.

2.4.13 Roundabouts

The design of roundabouts is to be in accordance with **AUSTROADS** guidelines and the RMS Supplements and is to be approved by the roads authority in the case of an existing road reserve or in the case of work not within an existing road reserve, the certifying authority.

2.4.14 Kerb and Gutter

Concrete kerb and gutter is to be constructed along all new and existing urban roads to which a development has frontage and access. Concrete kerb and gutter shall be provided generally in accordance with Table 2.1.

The kerb type (standard integral 150 mm or roll top kerb) is dependent on the road classification as shown in Table 2.1 or the relevant DCP and is to be in accordance with **Standard Drawing No. SD02**.

Standard integral 150 mm kerb shall be provided adjacent to public open space and reserves.

Laybacks in 150 mm standard integral kerb are to be constructed in accordance with **Standard Drawing No. SD02**.

Provision shall also be made for future roof and stormwater disposal from each allotment by providing one outlet at the lowest point in the kerb. A 150 mm by 50 mm Galvanised steel box section must be provided for all kerb types to accommodate stormwater disposal.

Kerb ramps shall be provided at all intersections in accordance with the standard drawing attached to this document.

Any variations to the above shall be approved at the discretion of **Council's Engineer**.

2.4.15 Vehicular Footway Crossings (Kerb to Boundary)

A separate Public Road Activity application and associated fee is required for approval of footpath crossings in existing public roads.

Where footpath crossings/laybacks and other similar activities are associated with development applications, reference must be made to standard drawings (shown within this document).

2.4.16 Kerb Returns

The design of kerb returns is necessary for all road junctions to ensure a smooth trafficable surface around the return and where necessary to locate low points for drainage purposes.

The minimum kerb line radius and splay of corner for all roads shall be in accordance with Table 2.5.

Table 2.5 Minimum Kerb Line Radii and Splay Corners

DEVELOPMENT TYPE	MINIMUM KERB LINE RADII[(1)]	MINIMUM SPLAY OF CORNER
Laneway		3.0 m x 3.0 m
Urban	9.0 m[(2)]	4.0 m x 4.0 m
Rural	12.0 m	12.0 m x 12.0 m
Commercial	12.0 m	12.0 m x 12.0 m
Industrial	12.0 m	12.0 m x 12.0 m

(**1**) On bus routes the geometry of the kerb return must be varied to allow for the larger turning circle.

(**2**) The entry and exit kerb line radii into cul-de-sacs shall be 16 metres in Urban and Rural areas and 30 metres in Industrial and Commercial areas.

Any variation to the above radii must be approved by Council's Engineers and should accommodate the intended vehicular movement using **AUSTROADS** templates. The specified minimum kerb radii and minimum splay corners may be subject to amendment according to intersection treatments and associated traffic control devices. Should such be identified for an intersection, then both radii and splays will be designed in accordance with the intersection treatment design

Where kerb returns are specified due consideration must be given to the following:

(a) The provision of kerb levels (on the nominal kerb lines) at tangent points, quarter points and wherever necessary to ensure accurate construction of junctions and turning heads;

(b) Offsets to all crests and low points to be shown on the kerb profile;

(c) The kerb return profile is to be generally designed by adopting the grades of the approach and exit kerbs to the return, by quartering the length of the return and by computing kerb

levels adopting two vertical curves as required; and

(d) Low points within the kerb return are to be avoided to eliminate the use of pits with curved lintels.

2.4.17 Perambulator Ramps

Kerb ramps are to be provided at all intersections, whether path paving will be constructed to that intersection or not. The position and layout of the perambulator ramp is to conform to that shown on the standard drawings with this document. All pram ramps are to be designed and constructed as lipless pram ramps.

Any variations to the above shall be approved at the discretion of **Council's Engineer**.

2.4.18 Bus Stops and Bus Zones

Bus Stops and Bus Zones shall be designed in accordance with State Transit Authority of NSW **'Bus Infrastructure Guide**' and **Disability Standards for Accessible Public Transport**.

2.4.18.1 Bus Bays and Parking

Large developments such as shopping centres and schools may require provision of bus bays or parking areas. When required bus bays and bus parking facilities shall be designed in accordance with the **RTA 'Guide to Traffic Generating Developments V2.2'**, **RMS TDT 2013/04 'Updated Traffic Surveys', Disability Standards for Accessible Public transport** and the relevant **Australian Standard**.

To address public safety from a criminal standpoint the location of bus bays and bus parking facilities must be assessed using the NSW Police **'Safer by Design'** or **Crime Prevention through Environmental Design (CPTED) principles and protocols**. In general, the location of the facilities should be such that they do not provide concealment opportunities.

Reference should be made to **Council's DCP** for specific bus shelter types, styles and colours applicable in the Camden Council LGA.

2.4.19 Car Parking

Car Parking shall be designed in accordance with the relevant DCPs adopted by Council, **AS/NZS 2890** and the relevant provisions of **AS 1428.1** .

2.5 PAVEMENT DESIGN

A formal pavement design is to be prepared by a suitably experienced person and certified on the plans, by a suitably qualified Engineer for each new development where pavements are required or where traffic loadings have been increased on existing pavements. Pavement designs are to be submitted based on sampling and testing of the subgrade materials taken from the site by a NATA registered laboratory. Two (2) copies of the details of the pavement design and results of the subgrade testing (including CBRs's) are to be submitted to Council for approval prior to commencement of pavement construction. Under no circumstances are any roadwork's to commence prior to approval.

Pavement thickness calculations are subject to variation should changes in the subgrade become evident during construction or due to spatial variations in the subgrade. Confirmation by a suitably qualified Geotechnical Engineer of preliminary subgrade conditions will be required following initial excavation. In deep cuttings, deep fills or other instances where testing of subgrade is possible only at the time of construction, a separate pavement design will be required during construction.

Pavement design shall be based on the assessed subgrade strength and the Traffic Loading Criteria (equivalent standard axles ESA), which is based on the Design Traffic Loadings shown in Table 2.1.

Notwithstanding the guidelines and reference documents provided in this specification, the structural design of the pavement must be in accordance with the following procedures.

Roundabout and intersection pavements shall be designed to addressthe torsion loads applied to the pavement by moving vehicles. This is to be demonstrated on the design plans..

The Engineering Plans must indicate the extent of any pavement treatments and designs required. Reference can then be made to the pavement treatments and designs certified on the plans, by a suitable qualified Geotechnical Engineer for specific details including depth and type of material to be used for each pavement layer.

A minimum DGB20 thickness of 150mm shall be adopted for all road type categories with the exception of concrete roundabouts where specified.

(a) For N values equal to or less than 5×10^5 ESA:

Pavements should be designed using the general principals of the **AUSTROADS AGPT02/12 'Guide to Pavement Technology - Part 2 Pavement Structural Design**' and **AP-T36-06 'Pavement Design for Light Traffic – A Supplement to Austroads Pavement Design Guide'**;

(i) Asphaltic concrete wearing courses should be designed with a minimum 40 mm layer of AC10 Residential Mix from **AGPT04B/14 'Austroads Guide to Pavement Technology - Part 4B Asphalt'**, applied in a single layer and laid on a single coat flush seal. Under no circumstances must the wearing course be assumed to have structural strength.

(b) For N Values greater than 5 x 10S ESA and Roundabouts:

(i) Pavements should be designed using the general principles of the **AGPT02/12 'Austroads Guide to Pavement Technology - Part 2 Pavement Structural Design'**;

(ii) Asphaltic concrete wearing courses should be designed with a minimum 40 mm layer of AC10, applied in a single layer and laid on a single coat flush seal. Under no circumstances must the wearing course be assumed to have structural strength;

(iii) Asphaltic concrete pavements for roundabouts and cul-de-sac heads are to have a minimum 75 mm thick SBS Polymer Modified AC surface layer to accommodate twisting and torsion effects.

(c) Rigid Pavements:

Rigid pavements should be designed using the **CC&AA T51 'Guide to Residential Streets and Paths**'. Reference may also be made to **AGPT02/12 'Austroads Guide to Pavement Technology - Part 2 Pavement Structural Design'**, **RMS Form 76 (supplement to the AUSTROADS guide)** and the **RMS 'Concrete Pavement Manual'**.

(d) Segmental Paving Areas:

For segmental paving areas (High Density concrete pavers) a concrete pavement should be designed underneath the pavers in accordance with the design method for rigid pavements and neglecting the thickness and any structural strength of the paver units.

(e) Alternative Designs:

Alternative designs may be submitted accompanied by supporting evidence, certified by a suitable qualified Geotechnical Engineer, as to the bearing capacity of the subgrade and the structural adequacy of the proposed pavement.

(f) Sub base and Base Materials for Industrial Roads:

Sub base and Base materials for industrial roads must comply with **RMS Specification 3051**.

(g) Salinity:

The contractor must thoroughly investigate the site to determine if there are any salinity issues which need to be addressed. If problems are found, the contractor must address them. Steps taken may include, but are not limited to;

(i) Minimising depth of excavation/disturbance required for roadwork's;

(ii) Minimising infiltration of surface waters by providing adequate sub-soil drainage;

(iii) Provision of adequate drainage for upstream catchments; and

(iv) Use of appropriate materials in construction of roadwork's;

Consultants should also follow the guidelines set out in **Section 4.4** of this Specification.

(h) Water Sensitive Urban Design:

If Water Sensitive Urban Design (WSUD) features (e.g. bio-retention swales) are proposed, considerations must be made with regard to the pavement design in areas adjoining these measures, to avoid the potential impacts from frequent water logging and the subsequent impact on adjoining pavement materials. Selection of WSUD water treatment devices shall take into consideration the potential for traffic disruptions when carrying out maintenance or replacing these devices so as to minimise traffic disruption (i.e. minimum distance to live traffic in accordance with WorkCover requirements). Consideration shall also be given to the ease of using modular units for replacing plants.

2.5.1 Design Traffic Loading

The minimum Design Traffic Loadings used to undertake pavement designs is dependant on the road classification as shown in Table 2.1. The figures provided are minimums only and may be increased by the Council Engineer depending on the circumstances with each development.

Care must be exercised where unusual circumstances occur, which will increase the traffic loading, such as:

(a) Large volumes of construction traffic, particularly major land filling requirements.

(b) Quarry traffic;

(c) Industrial traffic route;

(d) Potential for future expansion of the road; and

(e) Potential for future development adjoining the road.

In such cases further assessment of the design traffic loading is required.

Rigid pavements are extremely sensitive to individual heavy traffic loads as well as cumulative loading. If a rigid pavement is being considered then a full traffic analysis is required in accordance with **'Austroads Guide to Pavement Technology - Part 2 Pavement Structural Design'**.

2.5.2 Evaluation of Subgrade

Council will require investigation and testing by a suitably qualified Geotechnical Engineer of the anticipated subgrade material in accordance with **AS 1289.0** . The Geotechnical Engineer shall have a Level 1 responsibility in accordance with **AS 3798** .

Consideration of the likely pavement moisture environment and its effect on the material strengths is inherent in subgrade investigations. During soil sampling note should be taken of the soil strata, water table and topography. These notes plus field moisture content results and the vertical alignment of the proposed construction are then considered to determine those areas where moisture is likely to be a problem and to design suitable control measures.

Design subgrade California Bearing Ratio (CBR) values shall be determined by a suitable site investigation, generally in accordance with **'Austroads Guide to Pavement Technology - Part 2 Pavement Structural Design'**, **'Pavement Design for Light Traffic – A Supplement to Austroads Pavement Design Guide'** and **AS 1289.0**. The investigation will include sample data recording of test boreholes excavated to a minimum depth 1-metre below the design subgrade levels (unless rock is encountered). Soil samples shall be taken at the subgrade design depth and CBR tests undertaken after 4-days of soaking.

The testing authority responsible for the subgrade investigation must be fully satisfied that the location and depth of the test samples have been accurately surveyed to ensure that the sample represents a material which will remain in place when the subgrade is exposed. To this end, location, identification and sampling of subgrade materials shall be carried out in accordance with **AS 1726** .

In general the location and frequency of sampling and testing shall consider the following:

(a) In similar subgrade conditions sampling shall be carried out at intervals not greater than 50 meters and testing at intervals not greater than 100 meters;

(b) In variable subgrade conditions the above intervals will need to be reduced accordingly;

(c) Sufficient soil sampling and testing must be undertaken to ensure that all soil types represented in the subgrade are properly identified and tested for pavement depth requirements; and

(d) At least two (2) samples shall be taken from each road subgrade unless approved otherwise by **Council's Engineer**.

Where reconstruction of existing pavement is proposed subgrade investigation is generally to be in accordance with **AGPT02/12 'Austroads Guide to Pavement Technology - Part 2 Pavement Structural Design'**, **AP-T36-06 'Pavement Design for Light Traffic – A Supplement to Austroads Pavement Design Guide'**. Benkelman Beam testing of the existing pavement is to be carried out to provide a representative subgrade CBR. Where the CBR value is shown to be less than 4.0, the subgrade must be stabilised or replaced to provide a minimum CBR of 4.0.

2.5.3 Road Surfacing

The wearing course for all new roads and for the widening of existing roads shall be designed by a suitably experienced person and certified on the plans by a suitably qualified Geotechnical Engineer as part of the full pavement design. The road wearing course must not be considered to provide structural strength.

The minimum wearing course design shall consist of 40 mm of AC10, placed in a single layer, on a single coat hot bitumen flush seal.

The placement of the AC10 wearing course shall not be undertaken until all utilities and services have been installed and permission obtained from **Council's Engineer**. Works are to be completed prior to the final inspection by **Council's Engineer**. The values in Table 2.6 are to be adopted when selecting asphalt mix size.

Table 2.6 Selection of Asphalt Mix Size

Size (mm)	Layer where used	Layer thickness range
10 mm	wearing and regulation	25 - 40 mm
14 mm	as above and intermediate	40 - 50 mm
20 mm	base, intermediate, regulation	50 - 100 mm

2.5.4 Pavement Materials

All road pavement materials for unbound base and unbound sub base shall comply with the requirements

of Camden Council's **Engineering Construction Specification**.

2.6 PRIVATE ROADS

Private roads refer to Rights of Carriageway, battle axe roads and community title roads within private developments such as Community Land Development and Cluster Housing Schemes.

Council will require Engineering Plans for all private roads unless specifically exempted in an approval, and are to be submitted prior to the construction of any new private roads.

Private road pavements may be designed and constructed as full flexible pavements or rigid pavements (i.e. reinforced concrete on a flexible sub base). The requirements of **Section 2.5** of this Specification shall apply.

Note: Private roads will not receive Council road maintenance and as such may require a higher standard of construction than comparable Council roads. To reduce future maintenance demands to the local community.

2.6.1 Private Road Reserve and Road Widths

The minimum private road reserve and pavement widths are dependant on road classifications and shall be in accordance with Table 2.7.

Table 2.7 Minimum Private Road Widths

PRIVATE ROAD CLASSIFICATION	PAVEMENT	RESERVE
1. Urban up to 2000m^2 (1/2 acre)(1)	3.0 m	3.5 m
2. Rural up to 4000m^2 (1 acre)(1)	3.0 m	6.0 m
3. Rural up to 20000m^2 (5 acre)	3.0 m	10.0 m
4. Rural over 20000m^2 (5 acre)	3.0 m	10.0 m to 20.0 m

(**1**) Classifications 1 and 2 shall be limited to a maximum of 60 metres in length without a passing bay.

The minimum width of sealed strip shall be as directed by Council, with absolute minimum of 3 metres and shall consist of a two coat flush seal or asphaltic concrete.

2.6.2 Geometric Design of Private Roads

Design of private roads shall commence at the street property boundary adopting the designed footway levels and gradient at that boundary. For the purpose of this clause, private roads are defined as those roads within a community title development.

Private roads shall be designed generally in accordance with **AS/NZS 2890.1** and shall include adequate turning areas to allow all vehicles, including Heavy Rigid Vehicles, to leave sites in a forward direction.

It is important that vehicular access from the edges of a private road pavement into a lot is unrestricted by steep batters. Accordingly the longitudinal grading of the private road shall follow the grading of the natural surface along the alignment with edge earth works to ease the movement of vehicles across these areas. A uniform one-way crossfall is generally adopted over the full width of the pavement.

Where provisions are included within the Subdivision for private roads, full design details shall be provided in the Engineering drawings including:

(a) Plan, longitudinal sections and typical cross section details in accordance with **Section 2.2** of this Specification;

(b) Drainage details in accordance with **Section 3** of this Specification;

(c) Structural details of any retaining walls;

(d) Maximum grade of 12% (absolute maximum of 16%) and a minimum grade of 1%;

(e) Standard carriageway crossfall of 3% over full width;

(f) Standard footpath crossfall of 4% sloping towards pavement over a 1 metre width; and

(g) Batters with a maximum slope of 1(V):6(H) from edge of footway. This is particularly important in the utility and service corridor area in order to provide a suitable surface for the utility authorities to excavate and lay underground mains.

Where practicable, the crossfall of a private road shall be designed reverse to the existing slope of the natural surface to permit the pavement area to act as a drain for surface drainage control. In residential areas kerb and gutter and relief drainage shall be provided.

2.7 UNDERGROUND UTILITIES AND SERVICES

Adequate provision shall be made within the development/subdivision for the installation of Water Supply, Sewerage, Electricity, Telecommunication and Gas Services in conjunction with the relevant authorities. It is the applicant's responsibility to ascertain the requirements of all Utility Authorities, and shall bear the cost of all fees and charges associated with the provision of their mains and cables.

The location of proposed conduits beneath the carriageway is to be generally in accordance with **'Guide to Codes and Practices for Streets Opening'.**

Where new subdivisions depart from general practices in terms of road widths and the provision of footways the NSW SOC will assist in recommending utility and service space allocations that facilitate future coordination between all affected parties.

Notwithstanding the guidelines and reference documents provided in this specification the following must be considered when providing for underground utility and services:

(a) Main and cable conduits must be placed under road carriageways during construction and no later than subgrade stage unless otherwise approved by Council;

(b) All conduits shall be placed prior to sealing;

(c) The alignment of any conduits laid shall be marked on the face of the kerb (refer to Council's DCP for further information on service marking colours and styles);

(d) All conduit trenches shall be at a minimum grade of 1% in the direction nominated by Council and shall be drained;

(e) Common or 'shared' trenching between Electricity, Telecommunication and Gas utilities and services is to be carried out where possible;

(f) The conduits that cross the roadway and are under the road pavement shall be laid with a minimum cover of 750 mm and shall extend to a point a minimum of 300 mm behind the kerb faces or concrete edges;

(g) Backfill material and compaction shall generally comply with the requirements of pipe bedding in Camden Council's **Engineering Construction Specification**; and

(h) Proposed utility and services crossing existing roads shall be provided using a trenchless technique in accordance with Council's Construction Specification so as not to damage the existing surface.

The SOC Guidelines provide no specific allocation for trees in footways up to 3.6 metres wide. The applicant must consult with the Utility Authorities and Council's Landscape Compliance Officer if tree planting is required and due consideration must be given to tree species.

The applicant shall be responsible for any damage caused by the development to the existing public

utilities, footpaths or public roads and for the restoration of footpaths and roadways after the installation of utilities and services till the end of the maintenance period.

If, as a result of design, any alteration to an existing utility is considered necessary by the **Council Engineer**, it will be the responsibility of the applicant to make the necessary arrangements with the appropriate authority, and bear the cost.

2.7.1 Water and Sewer Utilities and Services

No development shall be carried out in respect of any land unless and until arrangements satisfactory to Sydney Water have been made by the applicant for the provision to such land of water and sewerage utilities and services.

Where sewer drainage cannot be provided or is cost prohibitive, an application shall be submitted to Council for approval of on-site wastewater disposal in accordance with Council's Onsite sewerage management strategy/policy.

Prior to the release of the Subdivision Certificate Council will require that the applicant obtains a Section 73 Certificate from Sydney Water stating that adequate provision of water and sewer infrastructure has been provided.

2.7.2 Electricity Utilities and Services

Council requires that all allotments shall be provided with an electricity connection. It is the responsibility of the applicant to negotiate with the appropriate Electricity Authority. In the case of all subdivisions and developments involving the opening of new roads the applicant shall arrange with the Authority for the provision of underground electricity supply.

Attention is drawn to the existence of aerial electricity lines which may cross proposed allotments. The Electricity Authority shall be consulted in such cases.

Acceptance of the subdivision layout is subject to appropriate areas being allocated off the footpath for the location of pad-mounted substations. The location of these substations is to be to the satisfaction of the Electricity Authority, who will issue a written statement that these requirements have been satisfied.

Pad-mounted substations will not be permitted in Public Reserves without the prior written approval of the Consent Authority. Written permission must also be received from the Consent Authority for placement of any cables in public reserves prior to placement of cabling.

The applicant shall be responsible for installation of street lighting in subdivision proposals where new roads are to be opened, in accordance with the Preliminary Lighting Plan approved by Council prior to the issue of the Construction Certificate. Such lighting shall be installed and connected to the supply complete with all control equipment, but not commissioned. The commissioning of the street lighting will be arranged by Camden Council when it is considered appropriate.

Shared trenching is to be carried out where possible.

2.7.3 Telephone Utilities and Service

Council requires that all allotments in subdivisions involving the opening of new roads be served by underground telephone mains except where for technical reasons the Telecommunications provider determines that underground supply should not be provided.

Arrangements are to be made by the applicant with the Telecommunications provider for the provision of this service.

Shared trenching is to be carried out where possible.

2.7.4 Gas Supply

The applicant shall be responsible for negotiating with the appropriate Gas Authority for the provision of natural gas to the allotments within the subdivision. The applicant shall provide plans showing the location of gas mains in the subdivision and the location of conduits to be placed across subdivision roads, at suitable intervals.

Shared trenching with Electricity and Telephone cabling is to be carried out where possible.

2.7.5 Shared Trenches

Shared trenches for the provision of Electricity, Telephone and Gas cables are to be provided where possible.

Shared trenching is to be undertaken generally in accordance with the **'Guide to Codes and Practices for Streets Opening'**.

Where new subdivisions depart from general practices or where the shared trenching arrangement shown in the **'Guide to Codes and Practices for Streets Opening'** cannot be applied, details of alternative suitable shared trench configurations shall be obtained from the relevant Utility Authorities or from the NSW SOC.

SECTION 3 – DRAINAGE DESIGN

3.1 GENERAL

This section outlines Camden Council's general requirements for the design of stormwater for Urban and Rural areas. All drainage design and construction work within the area of Camden Council shall comply with these requirements unless approved by the **Council Engineer**. This section of the specification is in no way a comprehensive design specification and it is intended to be read in conjunction with and as a supplement to the following references:

(a) **AS/NZ 3500.3** 'Plumbing and Drainage - Stormwater Drainage';

(b) Australian Rainfall & Runoff (1987);

(c) National Construction Code Vol 2 - 2016

(d) Camden Council's Local Environmental Plan;

(e) Relevant Council DCPs adopted by Council;

(f) Managing Urban Stormwater - Soils and Construction (Vol 1) (4th);

(g) Water Sensitive Urban Design Technical - Guidelines for Western Sydney (2004);

(h) Map of Salinity Potential in Western Sydney (2002);

(i) Guidelines to accompany the Map of Salinity Potential in Western Sydney 2002

(j) WSROC Western Sydney Salinity Code of Practice (2004);

(k) OEH Local Government Salinity Initiative Publications (various);

(l) NSW Floodplain Development Manual (2005);

(m) Stormwater Drainage Assset Management Plan 2011; and

(n) Council's Flood Risk Management Policy No. 3.19 (2006).

Detailed drainage investigations and designs are required to be undertaken by an experienced person and certified on the plans by a suitable qualified Civil Engineer and shall be in accordance with **Australian Rainfall and Runoff (1987)**. An objective of the investigation is to identify all flooding extents, both from mainstream flooding and overland flowpaths.

The design coefficients and parameters in this specification are applicable only to the Camden Council local government area.

3.1.1 Objectives

The drainage design shall reflect the following objectives:

(a) A high level of safety for all users;

(b) Acceptable levels of amenity and protection from the impact of flooding;

(c) Retention of the natural stormwater system where possible and as required by other statutory authorities;

(d) Efficient conveyance of stormwater and surface runoff from public and private property to ensure public safety and property protection;

(e) Controlled rate of stormwater discharge to reduce downstream flooding impacts by making maximum use of open spaces and other available areas to detain drainage;

(f) Ensure that the capacity of downstream drainage systems are not exceeded;

(g) Ensure that the stormwater drainage design has considered infrequent floods greater than the

design flood;

(h) Minimise construction and maintenance costs and avoid the need for future property acquisition;

(i) Protection of the environment from adverse impacts of development by stabilising the landform, controlling erosion and maintaining/ enhancing regional water quality;

(j) Protection of aquatic biota and riparian vegetation;

(k) Meet water quality objectives and incorporate the principles of Water Sensitive Urban Design; and

(l) Ensure low maintenance and economically sustainable in the long term in relation to operation, maintenance and replacement costs.

To address public safety from a criminal standpoint all drainage design structures and system elements must be assessed using the NSW Police **'Safer by Design'** or **Crime Prevention through Environmental Design (CPTED) principles and protocols**. The development proposal must demonstrate how public safety and risk will be managed. The following will be considered in the assessment of proposals (this list is not exhaustive and requirements will vary from site to site):

(a) System elements which provide concealment opportunities will not be permitted;

(b) Vegetation which provides opportunities for concealment adjoining pedestrian areas will not be permitted; and

(c) Underground pipe and pit systems which are large enough for children to get into must be screened (with due consideration given to flooding implications).

3.1.2 Major / Minor Concept

The major / minor drainage concept, as discussed in **Australian Rainfall and Runoff (1987)**, shall be adopted for urban stormwater drainage design.

The 'Minor' system refers to the underground piped system and gutters capable of carrying runoff from minor storms. The 'Minor' urban drainage systems are to be designed to cater for an Annual Exceedance Probability (AEP) as determined in this Specification.

The 'Major' system refers to the overland flow paths which are to be designed to convey major storm flows when the capacity of the minor system is exceeded. The 'Major' urban drainage systems are to be of an 'open ' style and designed to convey storm flows up to the Flood Planning Level (FPL). Flows in excess of the 1% AEP event must be considered in terms of safety and impacts, but are not required to be fully contained within the major system. Major system flows designed to be conveyed in road reserves must be conveyed at a depth of less than 0.2 metres to allow for the safe access of pedestrians.

3.1.3 Concept Stormwater Management Plan

A concept stormwater management plan (also known as a stormwater drainage plan) is a drawing that depicts the process of capture and conveyance of stormwater. The Plan shall provide enough detail for Council to determine at the Development Application stage that the proposal will function in accordance with the relevant development controls and Engineering Specifications. Generally the following information is provided as a minimum:

Existing catchment characteristics, condition and practices:

(a) Identify catchment characteristics, condition and extents;

(b) Identify land use types and zoning e.g. residential, rural-residential, commercial and industrial; and

(c) Identify existing stormwater management systems, practices and processes.

Management objectives:

(a) Identify and assess values of the receiving systems and environment;

(b) Identify and assess activities or land uses with potential to damage the local or receiving environment;

(c) Identify stormwater threats;

(d) Identify the legal point of discharge; and

(e) Identify flood extents and that the development is in accordance with the flood policy.

Location, type, size/capacity of development area stormwater management devices:

(a) Identify location of all proposed works, such as, drains, pipes, pollutant traps, basins, infiltration areas and constructed wetlands; and

(b) Identify flow paths of major rainfall events.

Establish prioritisation process:

(a) Identify proposed ownership and land dedication process;

(b) Identify the phasing of any interim and permanent facilities; and

(c) Identify and assess connectivity to future, masterplanned facilities.

The plan shall be prepared by an appropriately qualified engineer.

3.2 DETAIL DRAINAGE DRAWINGS

Stormwater drainage design details shall be submitted with the engineering details and shall include but not be limited to methods, parameters, assumptions made for design purposes and calculations and certifications from the consultant that it has been prepared in accordance with **Australian Rainfall and Runoff (1987)**.

Full catchment details including areas are to be provided for checking with all stormwater drainage design. The extent of the catchment including that outside the development must be shown and accounted for in the calculations.

Each pit sub-catchment shall have a reference number/letter which must be consistently used on both the catchment plan and drainage calculation sheet.

3.2.1 Catchment Plan

A contoured catchment plan shall be provided at an appropriate scale as provided in **Section 1.8.2** of this Specification and shall show:

(a) The total catchment area that will drain to the downstream boundary of the development in hectares;

(b) The boundaries of all sub-catchment with contributing pervious and impervious areas in hectares, runoff coefficient and average grades; and

(c) Defined watercourses and drains, either natural or manmade, and marsh/swamp areas.

3.2.2 Drainage Layout Plan

A drainage layout plan shall be incorporated in the General Arrangement Plan and shall show:

(a) Boundaries of lots, roads, easement etc.;

(b) Existing and proposed drainage lines (both major and minor routes) identified with line numbers, pipe diameters;

(c) All drainage structures numerically identified and located by centreline chainage;

(d) Limits of open channels, inlet and outlet drains;

(e) Schedule of existing and proposed drainage structures including type, size, cover/lid description and identification number;

(f) The location of any public utility mains and cables crossing influenced by the work;

(g) Finished contours, crests and sags in roads;

(h) Table drains, overflow paths, pathways, private roads, roadways, all notable vegetation;

(i) Manmade features including control structures, energy dissipaters, detention basins, dams, edge of bitumen, kerb and gutter and fences;

(j) 1% AEP flood line and FPL if applicable;

(k) 5% AEP flood line where on-site wastewater disposal is proposed; and

(l) Overland flow paths for storms up to the 1% AEP and calculations showing flows are contained within road reserves, public reserves or drainage channels/swales ,assuming pipelines and pits are 50% blocked.

3.2.3 Drainage Calculations

A drainage report shall be presented generally in the form shown in **Australian Rainfall and Runoff (1987)**. The drainage calculations shall be included on the A1 sheets as part of the set of Engineering Plans and before the longitudinal sections.

3.2.4 Longitudinal Sections

The longitudinal section shall be plotted on the sheet so that the chainages run left to right across the sheet starting at the upstream end of the system and shall be drawn to a scale of:

(a) 1:500 horizontal

(b) 1:100 vertical

The longitudinal section shall show:

(a) Running chainages along the drainage line together with road centreline chainages where applicable;

(b) Reduced levels to AHD of natural surface and finished surface levels;

(c) Existing invert of drain where applicable;

(d) Design invert level and grade of pipelines, open drains, channels and watercourses;

(e) Lead in and tail out works to match existing forms;

(f) Invert levels at pit inlet and outlet;

(g) Alignment, length and design invert levels of stub lines;

(h) Datum levels to AHD;

(i) Pipe diameter, pipe type, pipe class and joint type;

(j) Capacity in m^3/s, design discharge flow in m^3/sec and discharge velocity in m/s;

(k) Hydraulic grade line and levels;

(l) The accurate position and level of any proposed and existing major utility and services in the vicinity of the pipeline;

(m) Drainage structures;

(n) 1% AEP water level in open channels including backwater effects;

(o) Velocity and flow depth product (in the case of open channels); and

(p) Work as executed row.

3.2.5 Cross Sections

For the case of open channels, cross sections shall be detailed at minimum 10 metre intervals and maximum of 30 metre intervals. Cross sections shall extend to show at least 5 metres either side of the proposed open channel works to show the transition with the natural form. Obstructions such as buildings, fences, constructions etc shall also be detailed, where necessary, to provide for the calculation of backwater effects.

Open channel cross sections shall be drawn at a scale of 1:100.

Generally survey information is to be provided for a minimum of 50 metres upstream and downstream of the work.

3.2.6 Special Drainage Structures

Any drainage structures not covered by Camden Council Standard Drawings shall be drawn to a scale of 1:20 or as otherwise suitable for the required detailing.

3.3 DRAINAGE DESIGN STRUCTURES

3.3.1 Approved Materials

Unless otherwise specified, only the drainage materials listed below may be used for all developments within the Camden Council LGA.

Consideration will be given to application of alternative materials if a site specific analysis indicates that issues such as saline vulnerability, bushfire propensity, design traffic loadings and or insufficient cover are an issue on the site. Prior to using alternative materials, approval by Camden Council must be obtained.

3.3.1.1 Reinforced Concrete Pipes (RCP)

Pipes shall be constructed with spigot and socket rubber ring joints and be of fibre reinforced concrete or precast reinforced concrete which shall conform respectively to the requirements of **AS 4139** and **AS/NZS 4058**. Spigot and socket rubber ring joint for fibre reinforced concrete pipe must be achieved using external collar.

The use of fibre reinforced concrete pipes must be supported in any salinity management plan for the project.

3.3.1.2 UPVC Pipes

In trafficable areas on private property, the use of UPVC pipe Class SN4 up to and including 300 mm diameter may be permitted. UPVC pipes shall be backfilled with approved compacted granular material (e.g. washed river sand) for the trench depth in trafficable areas and 150 mm above the pipe in other areas.

3.3.1.3 Pits

All pits must have an opening to the surface to permit a person to enter. All pits for pipes up to 1050 mm diameter are to be designed in accordance with **Standard Drawing No.SD12**. Where pipes sizes exceed 1050 mm structural details shall be provided and certified by a suitably qualified Structural Engineer.

3.3.1.4 Angle Pits and Junction Pits

Angle and junction pits are to be designed in accordance with **Standard Drawing No.SD14**.

3.3.1.5 Surface Inlet Pits

Where surface inlet pits or surcharge pits are required, they are to be designed in accordance with **Standard Drawing No.SD13**.

3.3.1.6 Special Pits

Circumstances may require the inclusion in the design of a special inlet pit or other special structure. The Council Engineer shall be consulted as to their use in a particular circumstance and of the inlet capacities to be used in each instance. A detail of any non Council standard pits shall be included on Engineering Plans.

3.3.1.7 Precast Pits

Precast pits shall not be used on public roads or public spaces (e.g. reserves, drainage channels, etc).

3.3.1.8 Headwalls

Concrete headwalls for pipe outlets greater than or equal to 900 mm diameter are to be cast in-situ. Precast concrete headwalls may be used for pipes outlets up to and including 825 mm diameter.

Concrete headwalls greater than or equal to 900 mm are to be designed in accordance with **Standard Drawing No.SD21**.

3.3.2 Pipelines

The following design criteria shall apply for pipeline drainage design:

(a) Pipelines are to be placed on the high side of roads wherever possible;

(b) The minimum grade in pipelines is to be 1.0%; a minimum grade of 0.5% for pipes with a diameter in excess of 900 mm may be permitted up to a maximum length of 50 metres;

(c) Where pipe grades are in excess of 15%, concrete bulkheads are to be placed at every second collar and are to be constructed in accordance with the engineering drawings;

(d) A minimum cover of 0.6 metres at the collar shall be maintained. Where this cannot be achieved the pipes shall be encased with reinforced concrete to ensure structural integrity of the pipe. Alternatively, a suitable reinforced concrete box culvert may be used;

(e) Pipes shall be located under the kerb and gutter so that the edge of the pipe does not encroach onto the footway beyond the back of the kerb;

(f) Pipelines shall be located at an angle of between 90 and 45 degrees to the road centreline;

(g) In general the selection of pipe material and class must be based on the anticipated design loading on the pipe and the proposed pipe cover;

(h) Pipelines within roadways and Council lands shall have a minimum diameter of 375 mm and shall be minimum Reinforced Concrete Class 2, spigot and socket, Rubber Ring Joint Pipes, constructed in accordance with **AS 4139** (where fibre reinforced concrete pipes are to be used) or **AS/NZS 4058** (where precast reinforced concrete pipes are to be used). Where fibre reinforced concrete pipes are to be used, a proprietary collar is to be applied over the pipe

joints;

(i) Curved pipelines where permitted are to be installed strictly in accordance with the manufacturer's recommended radii and specification; and

(j) Pipe Friction Coefficients are to generally be in accordance with Table 3.1.

Table 3.1 Recommended Pipe Friction Coefficients

PIPE MATERIAL	MANNINGS 'n'	COLEBROOK-WHITE 'K' (mm)
Concrete	0.013	0.60
UPVC	0.009	0.03

3.3.3 Pits

The following design criteria shall apply for drainage pit designs:

(a) A grade of 5% shall be provided across all pits regardless of changes in diameter or direction. This equates to 50 mm fall over a 1.0 metre pit;

(b) Surface inlet pits are to be designed with a maximum interval of 75 metres. The width of stormwater flows, associated with design AEP's noted in **Section 3.4.2** of this Specification, shall be a maximum of 2 metres and shall maintain a minimum 3.5 metres clear vehicular passage.

Note: clear vehicular passage is defined as within the road carriageway/central pavement that is clear of any ponding and any other obstruction.

(c) The minimum nominal lintel size for gully pits on grade is 1.2 metres clear opening;

(d) The minimum nominal lintel size for sag pits shall be 2.4 metres clear opening;

(e) Drainage pits are to be designed where possible so that inlet and outlet walls are perpendicular to the centreline of the inlet and outlet pipes;

(f) Drainage pits are to be designed where possible, so that the pipe centrelines intersect on the downstream pit face;

(g) Step irons are to be provided in all drainage pits deeper than 1.2 metres as measured from the top of kerb to the invert of the pit in accordance with the standard drawing attached to this document. The first step iron is to be provided a maximum of 0.6 metres below the invert of the gutter and are to be spaced 0.3 metres apart;

(h) All drainage pits are to be reinforced in accordance with the standard drawings. Pits > 2 metres deep are to be designed to a suitably qualified Structural Engineer's requirements. Refer to the standard drawings for further detail;

(i) Concrete is to have minimum compressive strength of 32MPa at 28 days unless otherwise approved by the **Council Engineer**; and

(j) All drainage pits are to be designed to minimise occupational health and safety impacts with special consideration given to the confined spaces legislation, this is to cater for safe working environment to the personnel carrying out maintenance work.

3.3.4 Culverts

Where culverts are used for road crossings and detention/retention basin outlet structures the following design criteria shall apply:

(a) Urban road or embankments shall have a minimum freeboard of 500 mm above the top water level of the 1% AEP flows;

(b) Rural road or embankments shall have a minimum freeboard of 500 mm above the top water level of the 5% AEP flows;

(c) Culvert inlets must be designed using a 50% blockage factor for the 1% AEP flow;

(d) A causeway or weir must be provided over the culvert for all events and blockage scenarios. Where the causeway is across a flood evacuation route, the velocity x depth product is not to exceed 0.4; and

(e) For box culverts, the base slab shall be cast in-situ and designed by a suitably qualified structural engineer.

3.3.5 Bridges and Large Culverts

Bridges are to be designed for the 1% AEP flow with a freeboard of 500 mm. The effects of a Probable Maximum Flood shall also be assessed. Afflux and hydraulic grade lines are to be assessed in all cases

The minimum clearance to be provided to the soffit of the bridge structure above the expected flood level is to be generally in accordance with Table 3.2.

Table 3.2 Minimum Clearance above Design Flood Level

BRIDGE/CULVERT STRUCTURE	**CLEARANCE (1)**
1. Box Culverts with waterway area greater than $10m^2$ and Deck used as road surface	500 mm
2. Bridges with concrete in structure and a maximum velocity less than 3 m/s	500 mm
3. Bridges with concrete in structure and a maximum velocity greater than 3 m/s	1000 mm
4. Bridges with no concrete in structure and a maximum velocity less than 3 m/s	1000 mm
5. Bridges with no concrete in structure and a maximum velocity greater than 3 m/s	1250 mm

(**1**) Clearance to underside of structure (soffit).

It is critical that freeboard and other design requirements are achieved during the designated flood on evacuation routes.

3.3.6 Subsoil Drainage

Sub-soil drains are to be provided behind all kerbs except where drainage lines are laid under the kerb and gutter. Sub-soil drainage lines shall be graded to suitable outlets such as stormwater pits.

Subsoil drainage shall be designed and installed with consideration given to the following:

(a) Subsoil drainage pipes 100mm diameter for a minimum distance of 3 metres are to be provided at gully pits, junction pits and culverts so that the upstream end of the subsoil drain is capped and the downstream end discharges through the pit wall at a level above the obvert of the outlet pipe flush with the inside wall;

(b) The subsoil pipe shall be laid on the kerb side of the stormwater drainage trench unless otherwise directed;

(c) Additional subsoil drainage is to be provided at locations of known seepage or springs;

(d) The subsoil drainage should consist of 100 mm diameter corrugated UPVC agricultural pipe in an approved geotechnical stocking. The filter sock shall be appropriately tied at the upstream end of the subsoil pipe to preclude the entry of filter material;

(e) The absolute minimum grade shall be 1%;

(f) Flushing points for cleaning out the subsoil drainage shall be provided at the ends of lines and at intermediate points such that the distance between pits and/or rises shall not exceed 60 metres;

(g) Flushing points shall be marked (SS) on the flush point cover, by means of a stencil approved by the **Council Engineer**;

(h) Additional subsoil drainage shall be installed if during the course of construction the **Council Engineer** considers them necessary; and

(i) For pipelines greater than 525mm subsoil drainage shall be provided on both sides of the trench.

Reference shall be made to Council's **Engineering Construction Specification** for subsoil drainage materials applicable to the Camden Council LGA.

3.3.7 Natural Watercourses / Open Channels

The natural watercourse or gully system that conveys stormwater runoff should be conserved with minor modifications for flood conveyance control. Where a man made system is required, it shall be designed as a 'soft' engineered system but with allowance for natural growth to ensure the intended function of the cross sectional area of the waterway. In cases where there is high potential for environmental impacts such as significant trees, archaeological sites etc, appropriate bank erosion protection measures shall be applied to ensure there are no impacts on adjacent or downstream properties.

A detailed examination of the effect of changes of alignment, grading and channel section shall be carried out to determine water profiles and to identify areas requiring scour protection.

The final design shall be carried out using dynamic flow analysis or uniform and steady gradually varied flow subject to **Council Engineer's** approval.

The following design criteria shall apply for natural watercourse / open channel design:

(a) Natural watercourses and open channels must be designed using an increased Manning's n coefficient, to represent snagging and partial obstruction of the channel by debris;

(b) A minimum 500 mm freeboard above the top water level of 1% AEP event is to be incorporated within the open channel;

(c) The product of velocity x depth shall not exceed 0.4 m^2/s for channels, watercourses and floodplain areas without safety fences;

(d) In grass lined channels, maximum flow velocity shall be 2.0 m/s for 1% AEP flows, unless otherwise approved by Council. The minimum flow velocity shall be 0.6 m/s for 100% AEP flows;

(e) Designs shall be based on subcritical flow with Froude Number no greater than 0.8. Otherwise measures have to be installed e.g. drop structures to reduce the bed slope;

(f) Adequate scour protection shall be designed for all discharge points into and out of the channel, or at any point in the channel where there is a significant change in flow conditions;

(g) For maintenance and safety reasons the batter slopes of grassed waterways, shall be a maximum of 1(V):4(H). Minimum crossfall in low flow channel shall be 2% with a depressed channel invert. Provision of access for maintenance machinery shall be incorporated in the design of all channels;

(h) Adjacent piped systems shall be connected to the low flow pipe system as a continuation of the side lines. If existing, the connection point shall be a surcharge pit capable of surcharging the side lines total discharge. Surcharge points shall occur in the channel batter below the 1% AEP water level;

(i) All open channels where velocity exceeds 2.0 m/s shall be stabilised with ground reinforcing material with a minimum life expectancy of 20 years. The channel upstream shall contain the estimated afflux and required freeboard through any culvert or bridge. Appropriate scour protection shall be included at the culvert or bridge outlet; and

(j) Energy dissipaters such as stilling basins or drop structures shall be introduced where the discharge velocity from pipes into grass lined channels is likely to cause scour or where considered necessary by Council.

All plans (both design and WAE) are to clearly delineate the extent/location of flood lines including the 5% AEP, 1% AEP, FPL and PMF.

Note. Details for Constructed Wetlands and Retention / Detention Basins are contained in **Section 4.3** of this Specification.

3.3.10 Filtering and Screening Devices / GPT's

The following should be considered when selecting filtering and screening devices:

(a) Filtering and screening devices to meet water quality targets;

(b) A minimum 3.5 metre wide reinforced concrete access (i.e. capable to withstand 30 tonnes load from heavy machinery/truck) with a turning head shall be provided for removal of pollutants from each filtering and screening device;

(c) Cleaning using machine/s parked on trafficable roads is allowed only if the vehicle/s can legally park and be operated safely without extra traffic controllers;

(d) A minimum depositional volume of 3 months shall be provided in the trap;

(e) The trap shall be designed to allow cleaning of pollutants using a suction wand from outside without any need to enter the unit, and all filters / screens shall be removable to enable cleaning outside;

(f) The device shall be low maintenance and a cost effective maintenance strategy shall be developed and included in the design submission; and

(g) Constructed using durable materials with an expected life of 100 years

(h) All metal components are to be 316 stainless steel; and

(i) Only Council approved proprietary water quality control devices are to be used,

(j) Pit baskets are not an approved device due to the increased maintenance requirements

(k) Access and space to the device shall allow heavy machinery to remove sediment and litter and lift up and clean screens outside the device. Truck access shall be as close as possible to the device to minimise spillage of material. The device shall not be anymore than 2.4 metres away from the kerb for a truck parked on the road to reach it.

The provision of filtering and screening devices shall be accompanied by supporting evidence from the respective manufacturer or designer as to the operation, performance and maintenance of the device. Designs shall address the considerations provided above and comply with the pollutant retention criteria in Table 3.3.

Table 3.3 Minimum Pollutant Retention Criteria

POLLUTANT	PERCENTAGE RETAINED
Gross Pollutants	80 - 100%
Coarse Sediment (> 0.5mm)	60 - 80%
Medium Sediment (0.1mm to 0.5mm)	50 - 70%
Fine Sediment (< 0.1mm)	40 - 60%

3.3.12 Maintenance

It is essential that maintenance costs associated with stormwater assets which will be handed over to Council are minimised. It is also mandatory that assets must be able to be maintained with plant and equipment which Council owns or can lease as required.

Management and annual (or periodic) maintenance requirements and costs for any system to be maintained by Council must be provided in the form of a Maintenance Plan developed by the applicant in accordance with these Specifications. Maintenance Plans are to be prepared in

accordance with the requirements outlined in Council's Construction Specification which compliments this Specification.

3.4 DRAINAGE DESIGN PROCEDURES

3.4.1 Rainfall Intensities

Basic Parameters for the Camden Council LGA are to be in accordance with Table 3.4.

Table 3.4 Design Coefficients and Parameters

CO-EFFICIENTS	VALUE
Skewness	G : 0.00
Short duration geographical factors	F2 : 4.29
	F50 : 15.79

Rainfall intensities (mm/hr) for various duration's and return periods are provided in Table 3.5.

Table 3.5 Rainfall Intensities for Camden

DURATION	1 YEAR	2 YEAR	5 YEAR	10 YEAR	20 YEAR	50 YEAR	100 YEAR
5 mins	87.8	99.2	128.3	145.3	167.5	196.7	218.9
6 mins	82.3	93.0	120.2	136.0	156.9	184.2	205.0
7 mins	77.6	87.7	113.4	128.4	148.0	173.8	193.4
8 mins	73.7	83.3	107.6	121.8	140.5	164.9	183.5
9 mins	70.3	79.4	102.6	116.1	133.9	157.2	174.9
10 mins	67.3	76.0	98.2	111.1	128.1	150.4	167.3
12 mins	62.2	70.2	90.7	102.7	118.3	138.9	154.5
14 mins	58.0	65.5	84.6	95.7	110.4	129.5	144.1
15 mins	56.2	63.5	82.0	92.7	106.9	125.4	139.5
16 mins	54.5	61.6	79.5	89.9	103.7	121.6	135.3
18 mins	51.5	58.2	75.1	85.0	98.0	114.9	127.9
20 mins	48.9	55.3	71.3	80.7	93.0	109.1	121.4
25 mins	43.7	49.4	63.7	72.1	83.0	97.4	108.3
30 mins	39.7	44.9	57.9	65.5	75.4	88.5	98.4
40 mins	34.0	38.4	49.5	56.0	64.5	75.6	84.1
45 mins	31.8	35.9	46.3	52.4	60.4	70.8	78.7
1 hour	27.0	30.5	39.3	44.4	51.2	60.0	66.7
1.5 hours	20.8	23.6	30.4	34.4	39.6	46.5	51.7
2 hours	17.3	19.5	25.2	28.5	32.9	38.6	42.9
3 hours	13.2	15	19.3	21.9	25.3	29.6	33.0
4.5 hours	10.1	11.4	14.8	16.8	19.4	22.7	25.3
6 hours	8.4	9.5	12.3	13.9	16.0	18.8	21.0
9 hours	6.4	7.2	9.4	10.7	12.3	14.5	16.1
12 hours	5.3	6.0	7.8	8.8	10.2	12.0	13.4
15 hours	4.6	5.2	6.8	7.7	9.0	10.6	11.8
18 hours	4.1	4.6	6.1	6.9	8.0	9.5	10.6
24 hours	3.4	3.9	5.1	5.8	6.8	8.0	9.0
30 hours	3.0	3.3	4.4	5.1	5.9	7.0	7.9
36 hours	2.6	3.0	3.9	4.5	5.3	6.3	7.1
48 hours	2.1	2.4	3.3	3.8	4.4	5.3	5.9
72 hours	1.6	1.8	2.4	2.8	3.3	4.0	4.5

3.4.2 Design Annual Exceedance Probabilities

Minor system design annual exceedance probabilities for piped drainage are to be in accordance with Table 3.6.

Table 3.6 Minor System Design AEP's for Piped Drainage

LAND USE	A.E.P
1. Rural and Urban Residential	20% AEP (1 in 5 year)
2. Commercial	10% AEP (1 in 10 year)
3. Industrial	10% AEP (1 in 10 year)
4. Non-Residential	10% AEP (1 in 10 year)
5. Inter-allotment drainage	20% AEP (1 in 5 year)

The safety aspect for the flow over the road for 1% AEP shall also be appropriately assessed using the velocity and flow depth relationships in **NSW Floodplain Development Manual (2005)**.

3.4.3 Catchment Areas

The contributing catchment area at any point is to be defined by the limits from where surface runoff will make its way, either by natural or man made paths, to this point. Consideration is to be given to likely changes to individual catchment areas due to the full development of the catchment. Catchment area land uses are to be based on current available land zonings or proposed future land zonings where applicable.

Where no detailed survey of the catchment is available, 1:4000 ortho photo maps are to be used to determine the catchments and to measure areas.

3.4.4 Impervious Percentages

Where actual information is not available, the impervious percentages of development for various land uses shall be in accordance with Table 3.7. These values represent the minimum impervious percentages to be used in Rational Method calculations and in computer models.

Table 3.7 Fraction Imperviousness

DEVELOPMENT TYPE	MINIMUM FRACTION IMPERVIOUSNESS
1. Passive Open Space	10%
2. Active Open Space	30%
3. Residential	75%
4. Medium Density	80%
5. Commercial/Industrial	90%
6. Roads	90%

3.4.5 Design Methods

Design of Urban stormwater drainage systems may be carried out by using the Rational Method or by the application of the computer models defined in the following sections.

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

3.4.5.1 Rational Method

Rational Method calculations to determine peak flows shall be carried out in accordance with **Australian Rainfall and Runoff (1987)**.

Coefficient of runoff calculations shall be included for the design storm and the 1% AEP storm.

The Kinematic Wave equation shall be used to calculate overland flow times of concentration assuming a minimum overland flow path slope of 1% in residential areas. A minimum time of concentration of 6-minutes and a maximum time of concentration of 15-minutes shall apply. If the time of concentration is in excess of 15-minutes a hydrograph method shall be adopted.

Surface roughness coefficients shall be used to calculate the times of concentration and shall generally be in accordance with Table 3.8.

Table 3.8 Surface Retardant Coefficients

LAND USE	KINEMATIC WAVE EQUATION n*
1. Road/Paved Areas Only	0.011
2. Normal Residential	0.080
3. Medium Density Residential	0.060
4. Industrial/Commercial	0.040
5. Parkland	0.150
6. Open Space (Natural Bushland)	0.300

A partial area check shall be undertaken for impervious areas and included in drainage calculations. The potential for partial area affects are increased in catchments that are not homogenous in terms of land use or slope.

3.4.5.2 Computer Models

Where catchments are large and reasonably accurate levels of flow rate prediction are necessary, the use of proprietary softwares for the hydraulic and hydrologic design is encouraged provided that the designer has expertise knowledge and experience with the specific software. The industry standard computer models presented in Table 3.9 are supported by Council.

Table 3.9 Industry Standard Computer Models

HYDROLOGY	HYDRAULICS	WATER QUALITY
DRAINS	HEC-RAS	MUSIC
RAFTS-XP	RAT-HGL	AQUALM
	MIKE-11	

Should consultants wish to use other models not listed, prior consultation with **Council's Engineer** is required in order to provide justification for the adopted models, expected orders of accuracy and associated assumptions.

The selected models shall be calibrated against historic flood data if available, otherwise against other calculation methods and results.

Hydrological loss models shall generally be in accordance with Table 3.10 unless verified by calibration.

Table 3.10 Adopted Loss Models for Selected Computer Models

ILSAX/DRAINS	Paved initial depression storage	1 mm
	Paved continuing storage	0 mm/hr
	Grassed initial depression storage	5 to 10 mm
	Grassed continuing storage	2 to 5 mm/hr
	Soil type	3
	MAC	3
RAFTS-XP	Pervious initial losses	10 mm
	Pervious continuing losses	3 mm/hr
	Impervious initial losses	1.5 mm
	Impervious continuing losses	0.0 mm/hr
	'B' multiplier	1

An investigation and design report shall be submitted stating all design parameters, modelling assumptions and report calculations. An electronic copy of computer input and output data files for all hydrological, hydraulic and water quality models shall be submitted, together with accompanying catchment and layout plans, for Council's records at the time of lodging the Engineering Plans.

3.4.6 Design Considerations

(a) Design of pipelines as part of the 'minor' urban drainage system shall generally be in accordance with the design AEP's outlined in **Section 3.4.2** of this Specification;

(b) The piped drainage system shall be designed using a Hydraulic Grade Line Analysis as an overall system, not in isolation, having regard to the hydraulic influences of the upstream and downstream system;

(c) Hydraulic grade/energy line calculations will be required for all pipelines, and these are to be shown on long sections. Consideration shall be given to the head available in order to determine whether the system can achieve the capacity required.

(d) The maximum HGL level shall be 150 mm below the ground level at each pit or manhole and along the pipeline for the design AEP event;

(e) Drainage systems shall be designed to drain by gravity to an existing road network or approved Council drainage system. Pump out systems will not be approved except in limited circumstances where a large basement carpark is proposed, in this instance the pumpout system shall comply with AS3500 and Councils requirements;

(f) Charged Lines will be not be permitted in any circumstance;

(g) Pipelines shall be designed for a minimum velocity of 1.0m/s for 100% AEP flow for self cleansing and a maximum velocity of 6.0 m/s for the design AEP for scour protection. The pipeline is to be designed so that the depths of the gully pits are sufficient to induce the designed velocity. Gully pits, junction pits and change of direction pits are to be so designed to minimise pressure head losses;

(h) Pipe inverts shall be designed as shallow as practical taking into consideration minimum pipe cover, physical constraints and hydraulic grade requirements;

(i) Pipelines shall be designed in straight lines between pits. Where possible, in order to reduce head losses, changes of direction greater than 90^{o} are to be avoided;

(j) For any pipe system, a downstream pipe of smaller diameter than the upstream pipe will not be permitted. The exception to this is drainage systems where surcharge has been designed for and approved by Council;

(k) Complex or unusual pipeline situations should be approved by the **Council Engineer** prior to the finalisation of design;

(l) Drainage shall not be carried a greater distance than 75 metres in pipelines without adequate inspection manholes. Where the pipeline diameter exceeds 1200 mm, this distance may be increased to 100 metres;

(m) Pipe inlets shall be designed using a blockage factor of 50% for the 1% AEP flow;

(n) Headwalls are to be designed using a blockage factor of 50% for the 1% AEP flow;

(o) The inlets and outlets to pipelines are to be designed so as to avoid scouring or silting velocities during storm flows, and adequate scour protection satisfactory to Council's Engineer is to be provided at the outlet of all stormwater lines. Scour protection measures (excluding kikuyu grass) is to be provided where the maximum velocity exceeds 2.0 m/s;

(p) Where determination of a tailwater level is in doubt, it shall be necessary to confirm the value with the **Council Engineer** prior to proceeding. Tailwater levels shall generally be in accordance with the Table 3.11.

Table 3.11 Recommended Tailwater Levels

OUTLET TYPE	ADOPTED TAILWATER LEVEL(1)
1. Free outfall	Pipe obvert
2. Discharge into receiving waters	Design AEP flood level
3. Discharge to an existing system (HGL unknown)	150 mm below the natural surface/invert of kerb
4. Discharge to a point designed to surcharge	Height of surcharge

(**1**) The tailwater level shall not be below pipe obvert.

(q) Standard pits shall be provided in drainage lines at all changes in grade, level or direction and at all pipe junctions;

(r) Pits, lintels and kerb outlets shall be fully constructed within 2 metres either side of the prolongation of common property boundaries;

(s) The locating of gully pits in vehicular entrances shall be avoided;

(t) The location of gully pits on curves is to be avoided and they are not to be placed in line with the normal passage of pedestrians;

(u) Gully pits on roadways are to be spaced so that flow width in the gutter shall not exceed 2 metres or the clear vehicle passage shall not be less than 3.5 metres for the design AEP;

(v) Bypass from any gully pit on grade is not to exceed 15% of the total flow at the pit (desirably full capture). The actual value of bypass is to be tabled in the Engineering Plans;

(w) Where flows in the gutter exceed 20 l/s and/or 1 metre in width at an intersection it is necessary to intercept these flows with a Kerb Inlet Pit;

(x) Inlet pits shall be provided at the upstream tangent point of curves in the gutter line, the radius of which is less than 30 metres;

(y) Additional inlet pits may be required at the discretion of the **Council Engineer** if blocking of a single pit could cause serious flooding;

(z) Sag pits shall be designed based on a maximum depth of ponding up to the top of the kerb. A minimum blockage factor of 50% shall be used to calculate ponding depth;

(aa) The velocity x depth product for the roadway gutter flow shall not exceed 0.40 m^2/s for the design AEP;

(bb) The velocity x depth product at overtopping the road at intersections shall not exceed 0.40 m^2/s for the design AEP;

(cc) Where surface inlet pits are located within open channels, they are to be designed at a maximum spacing of 75 metres. A lockable hinged grate shall used in all cases unless otherwise approved by Council. Generally the pits are to be located below the 1% AEP top water level and preferably at the channel invert;

(dd) All urban stormwater drainage designs shall incorporate an assessment of major system flows. The aim of this check is to ensure that the 1% AEP flow has a safe and adequate 'escape route' when the minor system fails;

(ee) The use of natural waterways, watercourses and drainage depressions to convey major system flows must be maximised and where opportunities exist to return formalised systems to a more natural state, these opportunities must be taken. A minimum 500 mm freeboard is to be provided between the top water level of during a 1% AEP storm event and the ground level of the developed site at that location in the watercourse, unless otherwise approved;

(ff) Roads, pathways and stormwater easements may also be used to convey and route major system flows, either to the trunk drainage system or to a low point with sufficient hydraulic capacity to capture the flows. The maximum depth of flow in the roadway formation shall not exceed 200 mm for the 1% AEP flow. Special consideration needs to be given to trapped low points where the overland flowpath may divert surcharge into properties.

The following should be considered when roads, pathways and easements are used to convey major system flows:

(i) Where a pathway is used as an overland flowpath, the crossfall in the footpath shall be reversed;

(ii) If the roadway capacity is inadequate, an estimate shall be made of the capacity of the pipe system under major flow conditions; and

(iii) Where stormwater easements are used as overland flow paths a restriction-as-to-user (RATU) shall be placed on the title of the affected lots preventing the alteration of surface levels within the drainage easement and limiting permissible fencing across the easement to an open form fence to allow overland flow to be contained within the easement;

(gg) The effects of the Probable Maximum Flood (PMF) shall also be analysed to ensure there is no catastrophic failure of the proposed system/structures which could cause property damage or human injury.

3.4.7 Pit Losses

The pit pressure change coefficient (Ku) for each pit shall be determined using the tables from the Missouri Charts. Notwithstanding, the following should be considered when adopting pit losses:

(a) The water level in a pit may be assumed to be coincided with the HGL level;

(b) When the water level (i.e. HGL) calculated is below the obvert level of the upstream pipe, the obvert level of the upstream pipe shall be adopted as the water level for calculation of upstream pipe HGL;

(c) Where pits are located at the top of a drainage branch or where the obvert of the outlet pipe is one quarter ($^1/_4$) of its diameter or greater below the invert of the upstream pipe then the Ku shall be no less than 4.5;

(d) Intermediate cases may be determined by linear interpolation of Ku up to 4.5; and

(e) For drop pits with more than 600 mm drop, the length of the pit shall be designed to avoid direct fall onto the wall which will induce scouring of the pit wall. As a conservative starting point, this may be achieved by assuming a 45 degree angle down from the horizontal taken from the obvert of the inlet pipe.

3.5 INTERALLOTMENT DRAINAGE

The installation of interallotment drainage systems is required where roof water and surface water cannot be discharged directly to the street gutter or Council's stormwater system. Interallotment drainage systems are intended to collect both roof water and surface water.

Interallotment drainage pipes are to be sized to accommodate 20% AEP flows assuming an impervious area per lot in accordance with Table 3.7. The interallotment drainage pipe size shall be a minimum 150 mm diameter and be laid at a minimum grade of 1%. In general hydraulic capacity, cover and grade requirements are to be in accordance with **AS 3500.3** .

The design of interallotment drainage systems shall include inspection pits/manholes at the upstream end of the line and at the lowest point of each lot along the line with a maximum interval of 75 metres. Pits shall also be provided at changes of pipe grade, size or direction. The minimum internal dimensions of interallotment drainage pits shall be in accordance with **AS 3500.3** .

Interallotment drainage line connections to stormwater drainage lines shall be provided by the construction of an inspection pit located inside the property boundary.

Interallotment drainage lines are to be located centrally within an easement a minimum of 1.5 metre wide and shall be located in the higher rather than the lower property.

The maximum number of lots served by an interallotment drainage line shall generally not be more than eight (8).

Each lot benefitted shall have a drainage pit for access to the pipe, and the pit shall be concrete and provided with a stub for roof water connection.

3.6 ON-SITE DETENTION

In most circumstances an On-Site Detention (OSD) system will be required by the **Council Engineer** for the reduction of the impacts of a development on a downstream drainage system or property. For example, developments sites within the catchment areas which have regional OSD basins constructed do not require OSD. However, developments which do not fall in this category will require OSD except for single residential and duplex developments

The following design criteria shall apply:

(a) The maximum discharge from the post-development site shall not exceed the pre-development flows for all storms up to and including the 1% AEP and shall not be concentrated;

(b) The methods to determine required storage volume may be a non-time translation hydrograph method (e.g. Wollongong method or Swinburne method) if the time of concentration for the catchment is less than 30 minutes, otherwise a time translation hydrograph method (e.g. Runoff Routing method) shall be used. For both cases, the capacity of the existing drainage system shall be checked to ensure no increase in flows;

(c) All aboveground OSD basins and below ground OSD tanks shall be located clear of any overland flow paths. The runoff from the whole development site shall be directed to OSD;

(d) Below ground OSD tanks will be approved for commercial and industrial developments only with the minimum orifice diameter in below ground OSD tanks to be 20 mm;

(e) Discharge from aboveground OSD basins for storms in excess of the adopted pipe system design AEP, shall be via a weir designed to have a maximum depth of flow of 150 mm in a 100 year AEP storm;

(f) All aboveground OSD basin outlets and below ground OSD tank orifices shall be protected by a screening device to minimise blockage;

(g) Car parking spaces and open spaces can be incorporated as an OSD component. When car

parking spaces or open spaces are to be utilised as OSD, the maximum permissible ponding depth in the 1% AEP is 150 mm. In other areas where the ponding depth exceed 300 mm a 1.2 metre high safety fence shall be provided;

(h) The desirable minimum slope on turf storage areas is to be 3% with an absolute maximum of 5%;

(i) The desirable minimum slope on paved areas is to be 0.5% with an absolute maximum of 1%;

(j) An emergency overland flow path shall be provided for all OSD in case of extremely large flows or improper operation of OSD outlet, the overflow shall not be directed towards adjoining properties;

(k) Unless otherwise approved by the **Council Engineer**, all habitable floor levels shall be a minimum of 300 mm above the 1% AEP ponding water level;

(l) All stormwater must fall by gravity to an approved drainage system. Discharge by use of mechanical pump system or charged lines is not allowed;

(m) Upon completion of construction a 'work as executed' plan shall be submitted to Council prior to final inspection; and

(n) At completion of construction of the on site detention system and prior to the issue of the Occupation/Subdivision certificate the applicant shall submit a detailed 'work as executed' plan, certified by a registered Surveyor or Civil Engineer confirming the volume of storage provided and that the as constructed OSD shall perform as designed.

(o) Consideration must be given to the likelihood of access by children in rainfall events and the subsequent need for fencing or other controls.

(p) A risk assessment shall be provided by the applicant to Council. The risk assessment shall include consideration of wall height / drops, standing water, escape routes, likely hood of children entering, etc.

(q) Recommendations of the risk assessment shall be incorporated into the design.

A 'restrictions-as–to-user' shall be created pursuant to Section 88E of the Conveyancing Act 1919 and submitted to Council indicating that the on-site stormwater detention area shall be maintained at all times to comply with the following:

'The proprietor of the land hereby burdened (herein called 'the proprietor') shall be at all times in respect of the land hereby burdened identified on the above-mentioned plan as 'stormwater drainage detention basin' (herein called 'the basin')';

(a) Construct, clean maintain and repair all pits, tanks pipe lines, orifice plates, trench barriers, walls, earth banks and other structures;

(b) Maintain the existing surface levels;

(c) Regularly mow and remove grass clippings and debris as necessary to ensure the efficient operation from time to time and at all times of the basin **PROVIDED HOWEVER** that Camden Council (herein called 'the Council') shall have the right enter upon the burdened lot with all necessary materials and equipment at all reasonable time and on reasonable times and on reasonable notice but at any time and without notice in the case of an emergency;

(i) To view the state of repair of the basin;

(ii) To ascertain whether or not there has been any breach of the terms of this covenant; and

(iii) To execute any work required to remedy a breach of the terms of this covenant if the proprietor has not within 14 days of the date receipt by the proprietor of written notice from the Council requiring remedy of a breach of the terms of this covenant taken steps to remedy the breach and without prejudice to the Council's other remedies the Council may recover as a liquidated debt the cost of such remedial work from the proprietor

forthwith up demand.

3.7 DRAINAGE EASEMENTS

Drainage easements are to be created in situations where stormwater is concentrated or discharged onto adjoining lands other than an existing easement or natural watercourse. It shall be the responsibility of the owner/applicant to obtain a drainage easement through such land, sufficient in dimension to convey the drainage to an easement or natural watercourse, and to transfer easement rights to Council or to the entities that benefit from the proposed drainage easement.

Where it is intended to create drainage easements for a new road provided in a subdivision, a notation shall appear on the linen plan creating the easement or easements pursuant to Section 88B of the Conveyancing Act 1919.

Where a drainage easement lies within a development which does not involve the opening of a new road, the owner/applicant shall transfer to Council or to the entities benefiting from the proposed drainage easement, any drainage easement provided in the subdivision and execute a transfer and grant of easement in favour of Council or the benefiting entities, pursuant to Section 88B of the Conveyancing Act 1919.

The Subdivision Certificate will not be released until the above requirements have been complied with, and all fees and contributions have been paid.

Notwithstanding the requirements outlined above, creation of a drainage easement must consider the following hierarchy:

(a) The use of natural waterways, watercourses and drainage depressions as drainage easements must be maximised;

(b) Where a man made system is required, it shall be designed as a 'soft' engineered system such as grass lined channels; and/or

(c) Where the above cannot be provided a piped drainage system may be considered.

Structures adjacent to an easement shall be designed to utilise a beam and pier system of footing or other approved method designed by a suitably experienced person and certified on the plans by a suitably qualified Structural Engineer. The load shall be transferred to below the invert of existing pipelines within the easement. The zone of influence is considered to be defined by an envelope 45 degrees from a tangent line at the level of the invert of the structure (generally the footings).

3.7.1 Width of Easements

A drainage easement shall be provided over common and Council's pipeline within private property. The width of easement shall be generally in accordance with Table 3.12.

Table 3.12 Minimum Width of Easements

LOCATION OF EASEMENT	MINIMUM WIDTH[1]
Inter allotment Drainage – Residential[2]	The greater of the following: (a) 1.5 metres; or (b) (1.5 x depth of trench) + diameter of pipe
Inter allotment Drainage – Industrial[2]	The greater of the following: (a) 3.0 metres; or (b) (1.5 x depth of trench) + diameter of pipe

Council's Piped Drainage[2]	The greater of the following: (a) 3.0 metres; or (b) (1.5 x depth of trench) + diameter of pipe
Open Channel / Floodway	Top width of 1% AEP flow with freeboard + 3.0 metres[3]

(**1**) Easement widths to be increased in 0.5 metre increments.

(**2**) Minimum pipe cover is 0.6 metres.

(**3**) Additional 3.0 metres allowed for maintenance access on one side of the channel.

Where pits are required in easements, the width is to be at least 600 mm wider than the pit width.

A positive covenant, requiring maintenance of the easement by owners of land which contains the easement may be required, under Section 88E of the Conveyancing Act 1919.

3.8 FLOOD LIABLE LAND

Certain areas within the Camden Council are prone to flooding and these areas have been mapped to give an indication of their liability to flooding. Refer to the Camden Council's **Flood Risk Management Policy No.** for details.

Council discourages any development, including filling, within the identified floodways. Owners/ applicants with land in floodplain areas must comply with **Council's Floodplain Policy**. These areas shall be subject to special consideration and provision of additional information to Council.

SECTION 4 – SITE MANAGEMENT DETAILS

4.1 ENVIRONMENTAL SITE MANAGEMENT

Under the Protection of the Environment Operations Act 1997 (as amended), it is an offence to pollute any waters or to place any material in a position where it is likely to pollute any waters. Under the terms of this Act disturbing land by earthworks and not providing or maintaining adequate mitigation controls may constitute an offence.

In addition to the legislative requirements of this Act, urbanisation and associated development involves disturbance of the land surface and the generation of greater volumes of runoff than would occur in the natural environment. This may result in increased erosion and sedimentation rates if adequate safeguards are not put in place. Accordingly Council requires preparation and approval of a site specific Erosion and Sediment Control Plan (ESCP) or Soil and Water Management Plan (SWMP) for each new development site. These plans are to outline the staging of works, sediment and erosion control measures, rehabilitation strategies and other works to be implemented to address the above concerns. The plans must reflect the dynamic / changing nature of the works and the required maintenance.

ESCP's are required for all sites while larger developments will require the more detailed analysis required in a SWMP. Developments requiring a SWMP include:

(a) Any development greater than 2,500 m^2;

(b) Residential development greater than 10 lots; and

(c) Any development adjoining a watercourse.

ESCP's and SWMP's are to be prepared in accordance with this Specification, Council's **Engineering Construction Specification** and the '**Managing Urban Stormwater - Soils and Construction'**. In cases where the above documents are in conflict, **'Managing Urban Stormwater - Soils and Construction' shall take precedence**.

It is essential that contractors comply with all relevant statutes, including the provision of the Local Government Act 1993, Soil Conservation Act 1938 and the Water Management Act 2000.

The applicant shall prepare and submit ESCP's to Council for approval prior to initiating any activities involving disturbance of the land surface. The ESCP must provide details and specifications for the adequate control of sediment and erosion prior to, during and after construction.

The design, implementation and maintenance of ESCP's are to be undertaken by an appropriately qualified person experienced in erosion and sediment control. Modifications and changes may be required to the erosion and sediment controls during the life of the work or activity. Failure to comply with the approved ESCP may result in the issuing of stop work notices or legal action being instigated under appropriate legislation.

4.1.1 Erosion and Sediment Control Plan

An Erosion and Sediment Control Plan shall be prepared at a scale no larger than 1:1000 and shall show as a minimum:

(a) Boundaries of road reserves, public reserves;

(b) Location of property boundaries and adjoining roads;

(c) Existing and final contours;

(d) Location of existing vegetation and proposed vegetated buffer strips;

(e) Location of critical areas (vegetated buffer strips, drainage lines, water bodies, unstable slopes,

flood plains and seasonal wet areas);

(f) Location of all proposed stockpiles and control methods;

(g) Diversion of uncontaminated runoff around areas to be disturbed (diverted flows must be returned to natural flow at downstream boundaries);

(h) The nature and extent of proposed earthworks, including areas of cut and fill;

(i) Location and design criteria of erosion and sediment control structures, both temporary and permanent;

(j) Location of a stabilised all weather access point including provision for a temporary construction exit;

(k) Specifications for maintenance of erosion control works;

(l) Details of the disposal of intercepted sediment;

(m) Schedule of works;

(n) Rehabilitation (techniques) proposals, temporary and permanent, for all disturbed areas; and

(o) Dust control measures.

The following general requirements are to be contained within all sets of plans and specifications;

(a) Upon completion of final earthworks or after written direction of Council, immediate silt conservation treatments shall be applied so as to render areas that have been disturbed, erosion proof within 14 days;

(b) All perimeter and siltation control measures are to be the first step in clearing or earthworks;

(c) The area over all stormwater and sewer lines not in streets is to be mulched and seeded as soon as possible but no later than within 14 days after backfill;

(d) No more than 150 metres of trench is to be open at any one time;

(e) Areas over electricity power, telephone and gas supply trenches are to be seeded and mulched as soon as possible but no later than within 14 days after backfill;

(f) All temporary earth berms, diversion and sediment basin embankments are to be track rolled, seeded or mulched for temporary vegetation cover as soon as they have been formed;

(g) All fills are to be left with a windrow at least 200 mm high at the top of the slope at the end of each day's earthworks, and all earthwork areas shall be rolled each evening to "seal" the earthworks;

(h) All final erosion prevention measures, including establishment of grassing, are to be completed prior to the subdivisions final inspection;

(i) Stabilisation of all cut and fill slopes shall be commenced within 14 days of completion of formation;

(j) A strip of turf is to be placed immediately behind the kerb and gutter on all new roads and at additional locations as determined by the **Council Engineer**;

(k) All topsoil is to be stockpiled on site for re-use (away from trees and drainage lines). Measures shall be applied to prevent erosion of the stockpiles; and

(l) Establishment of fire breaks shall be carried out in consultation with a Fire Control Officer.

The design and construction shall be in accordance with the following reference documents:

(a) Soil Conservation Service of New South Wales, Technical Handbook No.2 **'Urban Erosion and Sediment Control Handbook (1992)**';

(b) **'Managing Urban Stormwater - Soils and Construction' (2004)**; and

(c) Camden Council **Engineering Construction Specification**.

4.1.2 Erosion and Sediment Control Measures

The following principles are important in controlling sedimentation and erosion and shall be considered in carrying out the design:

(a) The minimisation of site regrading. The disposal of any spoil from the site must be approved by the **Council Engineer**;

(b) Preservation of Flood Plains;

(c) Preservation of the existing natural vegetation by minimising the removal or disturbance of that vegetation. All notable vegetation shall be indicated on the plans;

(d) Establishment of a stabilised all weather access point including provision for a temporary construction exit to the site;

(e) Staged development with a limitation of 'borrow areas' and the need for quick restoration;

(f) The stripping and stockpiling of topsoil. On completion of earthwork, topsoil is to be replaced on all footpaths, batters and site regrading areas including drainage reserves and retention basins;

(g) Establishment of temporary vegetation on areas of high erosion hazard;

(h) Establishment of permanent vegetation and grassing immediately final grading is completed;

(i) The diversion of uncontaminated runoff away from all disturbed areas using diversion channels and banks;

(j) Location of temporary sediment basins on drainage lines during construction;

(k) The installation of storm drainage facilities as soon as possible;

(l) Use of temporary sediment traps or filter dams at the inlet or outlet of drainage system;

(m) The provision of temporary sediment basins at the outlet of drainage lines (refer to **Section 4.1.3** of this Specification);

(n) Use of gravel outlets at the discharge point of drainage systems;

(o) The installation of level spreaders to convert concentrated flow to sheet flow;

(p) Use of silt control fences, banks, mulch and other conservation measures where appropriate;

(q) The retention of buffer strips to streams, lakes and drainage channel banks;

(r) Establishment of temporary cut-off drains above steep batters until vegetation is established;

(s) The turfing of channel inverts, up to the 100% AEP flood level. The remainder of the channel shall be seeded/hydro mulched;

(t) Provision of shaker ramps or equivalent to prevent vehicles tracking site debris onto adjoining sealed roads;

(u) Batter to be topsoiled and turfed;

(v) Construction of sediment and erosion control devices at an early stage of the contract works; and

(w) Retention and maintenance of sediment and erosion control devices until disturbed areas are revegetated and stabilised to the satisfaction of the **Council Engineer** and the **Department of Primary Industries Soil Conservation Service**.

4.1.3 Sediment Basins

Sediment basins shall be provided at the downstream end of a construction site to intercept sediment laden runoff and retain the sediment, and shall be located offline. Sediment basins shall be sized to contain all the runoff for storms between the 33% AEP and 20% AEP depending on the site. In general sediment basins shall be provided in accordance with the following:

(a) Internal batters shall be provided consistent with personnel safety, i.e. 1(V):4(H) where unfenced or 1(V):2(H) where fenced;

(b) Compacted earth, rock or gabion embankment;

(c) Storage volume and basin maintenance/operation shall be in accordance with the publication '**Managing Urban Stormwater - Soils and Construction'** by Landcom;

(d) One or more inflow points carrying polluted runoff;

(e) A properly filtered outlet point;

(f) An emergency overflow spillway to provide for at least the 1% AEP critical duration storm for the catchment draining to the basin in its disturbed state;

(g) A basin de-watering device with filtration such that discharge does not cause downstream flooding;

(h) A marker peg to indicate water depth;

(i) All-weather access for sediment removal; and

(j) Measures to reduce erosion at the pipe outlet.

The sediment basin shall be maintained by the applicant until 80% of houses are completed or no longer required. The temporary sediment basins shall be removed and site restored at the applicant's cost.

Safety fencing, safety signage and hazard signage is to be provided during early release stages of a development, if the sedimentation basin is required due to ongoing construction activities. Safety and hazard signage is to be provided. Reference shall be made to Council's DCP for further information on sign types, styles and colours applicable in the Camden Council LGA.

4.1.4 Tree Preservation

No trees are to be removed without Council approval. A detailed plan of the trees to be retained shall be provided clearly defining any trees proposed for removal including those necessary for approved road and drainage works.

In general, all trees to be retained are to be protected by paraweb fencing, firmly staked 4 metres from the trunk of the tree. This fencing is to be erected prior to the commencement of any site works and is to be maintained in position for the duration of the works. The area within the drip line of the tree should not be used for the stockpiling of construction or demolition material, nor for vehicular or pedestrian convenience or uses that would compact the soil in this area.

Tree preservation measures in fill areas are to be undertaken in accordance with Council's requirements.

4.2 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

4.2.1 General

Australia's National Strategy for Ecologically Sustainable Development (1992) defines ecologically sustainable development (ESD) as 'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'.

In recognition of this principle, Camden Council has provided guidelines to address a number of critical areas in terms of engineering design.

4.2.2 Riparian Corridor Management

In accordance with current best practices, Camden Council requires the consideration of the following when designing and planning for riparian corridors in new release areas and .

(a) Protection of the natural/naturalistic system;

(b) Providing bed and bank stability;

(c) Protecting of water quality;

(d) Maintaining viability of riparian vegetation; and,

(e) Providing continuity and connectivity.

Other matters which will generally be considered include integration with floodplain processes, management of edge effects at riparian/urban interface, and protection of natural values within channels.

The integrity of many watercourses within the Camden Council LGA have been significantly compromised due to the diversion and channelisation practices associated with past development. Due to the hydraulic, geomorphic, and biodiversity implications of these impacts, the NSW Water Management Act 2000 directs that such activities be halted wherever possible. In many of the developed areas of Camden, development up to the flood extents does not allow formalised systems to revert to natural/naturalistic systems, however in new release areas key outcomes should include:

(a) Providing a minimum 'core' riparian zone width;

(b) Providing additional vegetation to a varying width to counter edge effects with urban interface;

(c) Bridge crossings to be provided for higher order streams;

(d) Rehabilitate/establish local provenance native vegetation;

(e) Locating utilities and services outside the core riparian zone wherever possible;

(f) Locating playing fields and other structures outside the core riparian zone; and

(g) Locating stormwater infrastructure, other than pipe and culvert outlets, outside the core riparian zone (and treating before discharge).

The minimum core riparian zone width will vary according to the classification of the stream which is able to be provided by Council.

When considering riparian corridor management, reference should be made to '**Fish friendly waterway crossings Policy and guidelines'** and '**Policy and Guidelines for fish habitat conservation and Management Structures'** for the crossing of any streams.

4.2.3 Conservation of Natural Wetlands

The conservation of natural wetlands is recommended, especially when undertaking the structure planning of new release areas. Along with providing a means of improving stormwater quality, natural wetlands can provide passive recreation, increase visual appeal of an area and provide wildlife habitat. Consideration of these factors should be given at the initial stages of design to provide a wetland that provides benefits to all users.

Natural wetlands incorporated within new developments may require rehabilitation due to damage and degradation associated through catchment changes or associated construction activities. Rehabilitation techniques include a range of passive management activities and construction activities such as:

(a) Flow regulation;

(b) Active planting within the wetland;

(c) Earthworks;

(d) Weed Control; and

(e) Implementation of flow control structures.

In general, the conservation and rehabilitation of natural wetlands shall be undertaken in accordance with best practice wetland restoration techniques. The following guidelines may be of assistance:

(a) **Australian Runoff Quality**;

(b) The **'Constructed Wetlands Manual'**; and

(c) **'Managing Urban Stormwater Using Constructed Wetlands'**.

Safety and hazard signage is required for any natural wetland proposed as part of a new development, to address public safety issues. Reference is to be made to Council's DCP for details on specific sign types, styles and colours applicable in the Camden Council LGA.

4.2.4 Rehabilitation of Farm Dam Wetlands

The rehabilitation and incorporation of existing farm dams as water quality and water quantity management measures should be considered, especially planning new release areas. Farm dams designed to operate as wetland and/or detention structures can become a valuable asset to any new development by providing water quality improvements, passive recreational facilities and increased visual appeal.

In general, existing farm dams are to be rehabilitated and designed to operate as constructed wetlands in accordance with the design criteria provided in **Sections 4.2.3** and **4.3.3** of this Specification and with consideration of the following:

(a) Size, shape and depth of the existing farm dam;

(b) The catchment area and the activities proposed in the catchment;

(c) Existing land use and pollution from farming activities within the catchment;

(d) Existing aquatic plants and the potential presence of weeds

(e) Suitability of soils present within the dam for plant growth;

(f) The hydrology of the dam location i.e. in a gully or on a hillside; and the

(g) Impact of large storm events and the location of proposed spillways and high flow bypasses.

The range of approvals and assessments may be required for farm dam wetlands depending on the nature and size of the existing farm dam and its location in the proposed development. Consultations may include but will not be limited to:

(a) An assessment of the proposed farm dam wetland **Consequence Category** determined by reference to **Dam Safety Committee Guidance Sheet DSC3A**. Additional emergency spillway capacity and/or reinforcement may be required due to the hazard category of the structure; and

(b) Submission of design plans to the **NSW Dam Safety Committee** for comment where the Committees guidelines warrant it.

Consultants are advised liaise with Council and the relevant agencies as early as possible to determine the need for any approval, licences or permits and to establish any investigation or data requirements for the application.

Safety and hazard signage is required for any rehabilitated farm dam wetland proposed as part of a new development, to address public safety issues. Safety and hazard signage is to be provided in accordance with the standard drawing attached to this document. Reference is to be made to Council's **'Camden Council Style Guide'** for specific sign types, styles and colours applicable in the Camden Council LGA.

4.3 WATER SENSITIVE URBAN DESIGN

4.3.1 General

All development is to incorporate Water Sensitive Urban Design (WSUD). WSUD is to be adopted

throughout the development to ensure sustainable and integrated management of land and water resources incorporating best practice stormwater management, water conservation and environmental protection.

WSUD details are to be submitted as part of any development and shall include:

(a) Identification of water management and other relevant objectives (for example, salinity hazards);

(b) Identification and assessment of relevant site characteristics and constraints, including flooding;

(c) Best planning practices and stormwater treatment measures (in both public and private domain);

(d) Assessment of the likely construction costs associated with the WSUD strategy as well as a maintenance framework addressing maintenance strategies and costs;

(e) Consideration of cost effectiveness of the WSUD elements, taking account of life cycle costs, ongoing operations and maintenance requirements, land take requirements, expected reliability and future management responsibilities; and

(f) A monitoring plan that encompasses strategies for water sampling, maintenance of WSUD facilities and risk management in the short, medium and longer terms.

WSUD designs shall demonstrate that Water Quality Targets set out in Table 4.1 will be achieved and shall be consistent with the relevant DCP, '**WSUD Technical Guidelines for Western Sydney'** and **Australian Runoff Quality.**

Compliance with the Water Quality Targets in Table 4.1 is to be determined through stormwater quality modeling in accordance with the parameters outlined in the '**WSUD Technical Guidelines for Western Sydney'** and this Specification.

The WSUD design is to take into account riparian zone and creek management and include the following measures:

(a) The ephemeral hydrology of creeks is to be maintained or restored, where possible, by diverting excess flow via intercepting stormwater pipes to downstream storages for reuse;

(b) Flow attenuation and/or diversion via the intercepting stormwater pipes will be required to meet the stream erosion index objectives of the Water Quality Targets set by Table 4.1;

(c) Flow in excess of the 20% AEP peak flow may flow into the creek and be conveyed to detention basins that form part of the major drainage system; and

(d) Erosion control and bank stabilisation measures shall be incorporated within the waterway where required.

Table 4.1 Water Quality Targets

ENVIRONMENTAL STORMWATER OBJECTIVES					
	WATER QUALITY (% reduction in pollutant loads)				**ENVIRONMENTAL FLOWS (Stream erosion index)**
	Gross Pollutants (>5mm)	Total suspended solids	Total phosphorus	Total nitrogen	
Stormwater management objective	90	85	65	45	3.5 – 5.0
'Ideal' stormwater outcome	100	95	95	85	1

(**1**) These load-based objectives are expressed as the reduction in pollutant loads required, compared to the proposed development with no stormwater control measures included.

(**2**) The 'stream erosion index' is defined as the post-development duration of flows greater than the 'stream-forming flow'

divided by natural duration of flows greater than the 'stream-forming flow'. For the purposes of these objectives, the 'stream-forming flow' is defined as 50% of the 2 year flow rate estimated for the catchment under natural conditions.

(**3**) Development proposals should be designated to achieve a value as close to one as practicable, and values within the nominated range should not be exceeded. A specific target cannot be defined at this time.

(**4**) These 'ideal stormwater outcomes' reflect the stormwater outcomes considered necessary to protect the receiving environment from the impact of urban development.

(**5**) Stormwater must achieve the specified water quality standards prior to leaving the subject property or discharging into a watercourse.

4.3.1 Hydrocarbons

The following developments shall reduce hydrocarbons, motor fuels, oil and grease by 90% of the average annual pollutant load for the 3 month average recurrence interval event: service stations, depots, vehicle body repair workshops, vehicle repair stations, vehicle sales or hire premises, and car parks with over 25 spaces.

4.3.2 Retention / Detention Basins

Detention or retention basins are required to attenuate flows where the peak flows due to the development are in excess of natural flows, or where required by Council. The basin shall be designed to perform in the full range of flood events up to 1% AEP. New retention/detention basins and other water quality control structures should be created as off-line to natural watercourses and open channels, unless otherwise approved by Council.

The following design criteria shall apply for the design of retention/detention basins:

(a) A freeboard of 500 mm for the 1% AEP event to be incorporated into the basin embankment unless otherwise specified;

(b) Grassed internal batters shall not be steeper than 1(V):4(H);

(c) Grassed external batters shall not be steeper than 1(V):4(H);

(d) The minimum slope of the basin floor shall be 1% unless otherwise specified;

(e) The minimum grade for other basin areas active in the 1% AEP event shall be 2%;

(f) For retention / detention basins with a maximum depth in the 1% AEP event of greater than 0.3 metres or a ponding time in excess of 2 hours, the retention/detention basin will be required to incorporate safety measures to prevent accidental entry;

(g) Depth indicators are to be provided indicating the maximum depth in the basin;

(h) Safety and hazard signage in accordance with Council's Standard Drawings is to be provided for the retention/detention basin to address public safety issues (refer to Council's DCP for further information on sign types, styles and colours);

(i) Inlet and outlet structures must have debris and scour control along with a safety fence where the maximum velocity is greater than 2.0 m/s;

(j) A reinforced concrete access to the retention / detention basin should be designed to allow machinery to remove sediment and litter. Truck access should be as close as possible to the basin to minimise spillage of material.

(k) Emergency spillways shall be designed to discharge the Probable Maximum Flood without catastrophic failure of the embankment. A suitable emergency spillway may be a broad crested overflow weir with its horizontal top at an elevation 0.3 metre above maximum storage elevation for 1% AEP. Special consideration shall be given to erosion protection on the spillways and the techniques proposed shall require the approval of **Council Engineer** to their final design;

(l) Additional emergency spillway capacity and / or reinforcement may be required due to the hazard category of the structure. The **Consequence Category** should be determined by reference to **Dam Safety Committee Guidance Sheet DSC3A**;

(m) In-ground retention / detention basin shall not present water / drowning hazards;

(n) Where basins are integrated into open space areas such as playing fields, a low flow pipeline shall be provided and due consideration should be made to ensure this form of basin will have minimum disruption during wet weather;

(o) Low flows through the retention / detention basin shall be by means of a low flow conveyance system. The actual form that this system will take (i.e. pipeline, concrete dish, etc.) shall be approved by the **Council Engineer** and shall be site specific;

(p) Low flow systems shall be sized to convey two thirds of 100% AEP flow;

(q) Low flow pipes shall not be smaller than 600 mm diameter;

(r) All exposed areas are to be grassed;

(s) Submission of design plans to the **NSW Dam Safety Committee** for comment where the Committees guidelines warrant it;

(t) Filling is to be carried out in accordance with **AS 3798** and shall be supervised by an suitable qualified Geotechnical engineer shall have a Level 1 responsibility; and

(u) Due consideration shall be given to geotechnical aspects and where required by the **Council Engineer**, a full geotechnical report shall be prepared by a suitably qualified Geotechnical Engineer.

4.3.3 Staging of Bioretention Facilities

Bioretention Facilities shall be designed and constructed in two stages.

The first stage will involve the facility being designed and constructed to its final form, except for the planting. The planting shall be substituted with a geotextile layer and turf.

The final planting of the bioretention facility shall be delayed until Occupation Certificates for dwellings associated with 80% of the lots for the catchment have been issued; or when directed in writing by Camden Council. Prior to planting, the sediment, turf and geotextile layer shall be removed from the water quality facilities with light machinery and to the requirements of the certifying authority.

A bond to ensure the second stage of works are completed shall be lodged in accordance with our bond policy.

4.3.4 Constructed Wetlands

The design of constructed wetlands requires expertise in a number a fields including hydrology, hydraulics and ecology. Many considerations including sequencing, sizing, hydraulic controls and aquatic planting need to be considered. In general, constructed wetlands are to be designed in accordance with the following design guidelines:

(b) **Water Sensitive Urban Design - 'Technical Guidelines for Western Sydney (2004)';** and

(c) Australian Runoff Quality (2006).

Constructed wetlands are to be designed to retain nutrients, heavy metals, bacteria and other pollutants. Constructed wetlands should be implemented as a component of WSUD in conjunction with other WSUD measures to achieve the water quality and water quantity targets outlined in **Section 4.3** Water Sensitive Urban Design of this Specification.

Access to constructed wetlands are to be designed to allow machinery to remove sediment, litter and to allow replacement of macrophytes. Truck access should be as close as possible to the device to minimise spillage of material.

Landscaping of constructed wetlands should be consistent with the composition and structure of the indigenous freshwater wetland ecological community.

4.4 SALINITY

4.4.1 General

Applications for subdivision and multi dwelling developments must undertake a detailed assessment of the salinity potential. The applicant is referred to the following documents for guidance on carrying out these investigations:

(a) Camden Council **Policy No. 1.15 - Building in a Saline Prone Environment (2004)**;

(b) Map of Salinity Potential in Western Sydney (2002);

(c) Guidelines to Accompany Map of Salinity Potential in Western Sydney (2002);

(d) WSROC **'Western Sydney Salinity Code of Practice'**; (2004);

(e) CC&CA T56 **'Guide to Residential Slabs and Footings in a Saline Environments'** (2005);

(f) LGIS **'Introduction to Urban Salinity'** (2006);

(g) LGIS **'Building in a Saline Environment'** (2003);

(h) LGIS **'Roads and Salinity'** (2003);

(i) LGIS **'Indicators of Urban Salinity'** (2006);

(j) LGIS **'Site Investigations for Urban Salinity'** (2002);

(k) Processes of Salinity (website);

(l) LGIS – Booklet No. 7 **'Waterwise Parks and Gardens'** (2004);

(m) LGIS **'Broad Scale Resources for Urban Salinity Assessment'** (2002); and

(n) Other OEH salinity resources currently being developed as they become available. For details: http://www.environment.nsw.gov.au/salinity/index.htm.

The following areas are at high risk of salinity must have a site-specific salinity investigation undertaken prior to development:

(a) Within 50 metres of a water course;

(b) In areas that have bare soil patches or salt scalds;

(c) On soils that appear 'puffy' when dry, or greasy when wet;

(d) In areas that have salt tolerant plant species;

(e) In areas that have white staining on nearby house foundations or walls; or

(f) On soils that are derived from Wianamatta Shale.

4.4.2 Site Investigations and Salinity Management Plans

Most of the Camden Council LGA has been identified as having the potential for salinity related problems if not managed appropriately.

All new release areas, major development sites and industrial developments will be required to undertake site-specific investigations to assess the potential for salinity. Site Investigations are to generally follow the requirements and guidance set out in **LGIS 'Site Investigations for Urban Salinity'** and the **WSROC 'Western Sydney Salinity Code of Practice'.**

Salinity Management Plans are required for all new development areas where salinity or the risk of salinity has been identified. This is to generally follow the requirements and guidance set out in Council's **'Building in a Salinity Prone Environment' policy No. 1.15 (2004)**, the **WSROC 'Western Sydney Salinity code of Practice'** and the measures presented in the following sections. The Salinity Management Plan must detail the salinity management measures that will be included in

order to minimise the impact to both public and private domain infrastructure including but not limited to parks, roads, stormwater systems, utility/service installations, houses, driveways and cut/fill areas.

4.4.3 Salinity Control Measures

The following salinity control measures shall be used (but shall not be limited to the following):

(a) House slabs and other concrete work:

(i) A layer of sand at least 50 mm deep under the slab in accordance **NCC clause 3.2.2.2** ;

(ii) A damp proof membrane (rather than a vapour barrier) in accordance with **NCC clause 3.2.2.6** , must be laid under the slab;

(iii) The damp proof membrane must be extended to the outside face of the external edge beam up to the finished ground level in accordance with **NCC clause 3.2.2.6** ;

(iv) Once installed, the damp proof course must not be breached by any later works or additions such as steps, verandas, walls, rendering, bagging, pointing, paving or landscaping;

(v) Class 32 MPa (N32) concrete must be used, or, a sulphate resisting Type SR cement with a water cement ratio of 0.5 must be used;

(vi) The minimum cover to reinforcement will be 50 mm to unprotected ground;

(vii) The minimum cover to reinforcement will be 30 mm to a membrane in contact with the ground;

(viii) The minimum cover to reinforcement will be 20 mm to an internal surface;

(ix) The minimum cover to reinforcement will be 50 mm for strip footings and beams irrespective of whether a damp proof membrane is used;

(x) Admixtures for waterproofing and/or corrosion prevention may be used;

(xi) Slabs must be vibrated to reduce air spaces;

(xii) Concrete must be cured for at least 7 days; and

(xiii) Appropriate sub-soil drainage must be installed for all slabs, footings, retaining walls and driveways.

(b) Brickwork:

(i) The damp proof course must consist of polyethylene or polyethylene coated metal in accordance with **NCC clause 3.3.4.0** and be correctly placed to prevent moisture movement;

(ii) Exposure class masonry units in accordance with **NCC clause 3.3.1.0** , must be used below the damp proof course including for strip footings;

(iii) Manufacturer's recommendations regarding suitability for use in saline environments for all bricks and concrete blocks should be followed;

(iv) Mortar in accordance with **NCC clause 3.3.1.0** , must be used and waterproofing must be added below the damp proof course; and

(v) Admixtures for waterproofing and/or corrosion prevention may be used.

(c) Open Spaces and Gardens:

(i) The principles of 'Waterwise' gardening should be used;

(ii) Watering of open space should be kept to a minimum;

(iii) Over watering must be avoided;

(iv) Keeping any areas requiring watering away from houses;

(v) Landscaping and garden design shall not be placed against walls;

(vi) Use of native endemic species to minimise water demands;

(vii) Use of mulch on garden beds to minimise water losses through evaporation;

(viii) Minimising the use of lawn areas;

(ix) Where lawns are used choose species to take into account water requirements, wear and tear, soil types, sun and shade and fertilise usage;

(x) Water use on the site shall be minimised and leaky pipes or drains repaired immediately to avoid water clogging;

(xi) The use of grey water for the watering of lawns and gardens shall be monitored to avoid water logging;

(xii) Appropriate mowing practices; and

(xiii) Not over watering.

(d) Development controls:

(i) Development is required to make the best use of existing site topography. Any proposals requiring significant moving and filling of earth will only be considered if it contributes to the overall quality of the development and the urban design outcomes for the area;

(ii) Cut and fill must be minimised within areas identified as a salinity hazard. In general any cut and fill required should not exceed 500 mm. Bulk earthworks involving cut and fill must be undertaken in accordance with a Salinity Management Plan approved by the Certifying Authority.

(iii) For road works within areas identified as a salinity hazard, the following must occur:

- Roads should run along and perpendicular to the contours as much as possible;
- Minimum disturbance of subsoil;
- Engineering designs incorporating consideration of salinity impacts are required;
- Subsoil drainage is to be installed along both sides of all roads; and,
- Alternative footpath treatments will be considered if the proposal will reduce the need for watering.

(iv) For utility/service installation within areas identified as a salinity hazard, the following must occur:

- Utmost care must be taken to ensure that no leakage occurs from water, sewer and stormwater pipes;
- Services should be joint trenched where possible (recommendations in the **'Guide to Codes and Practices for Streets Opening**' are to be followed);
- Transverse utility/service connections (across roads) must be laid in conduits placed at the time of road construction if the utility/service is not laid out at that time;
- Water supply pipes must be copper or a non-metal acceptable to Sydney Water; and
- Sewer pipes must be Unplasticised Poly Vinyl Chloride (UPVC) and acceptable to Sydney Water;

4.5 SITE REGRADING

4.5.1 General

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

(a) Alleviate flooding of low lying ground;

(b) Fill gullies or depressions after underground stormwater piping has been installed;

(c) Allow improved run off from flat ground;

(d) Condition excessively steep slopes that would preclude economical construction of dwelling foundations to floor level; and

(e) Allow effective recreational use or give reasonable access.

Where filling is proposed, provision is to be made to ensure that no water is ponded on any of the development lots or adjoining land. If filling is to be placed against adjoining property, provision is to be shown on the plan for the toe of fill batters to merge with the existing natural surface a minimum one (1) metre within the development, and for any necessary excavation within this unfilled strip to permit the free passage of water away from the adjoining land. Where it is proposed to fill any adjoining land, proof of the consent of the affected landowners shall be supplied to Council prior to the approval of the Engineering Plans.

Prior to issuing a Construction certificate in relation to site regarding works, the Council or the Certifying Authority must first sight a valid development consent, pertinent to the work being carried out.

4.5.2 Site Regrading Plan

Where land has been filled in excess of 300 mm, a Site Regrading Plan shall be drawn to a scale of 1:500 and shall include:

(a) Existing surface contours in broken light line;

(b) Finished surface contours in full heavy lines;

(c) Outlines of lots, roads, private roads and/or pathway, reserves adjacent to or contained therein;

(d) Cross sections and base line suitably identified; and

(e) Details of fill boundaries and depth of filling in maximum 0.5 metre increments shaded on the plan.

Site regrading cross sections shall be drawn to a suitable scale and shall include:

(a) Base line ordinate;

(b) Distances from base line and ordinates;

(c) Existing surface levels;

(d) Finished surface levels;

(e) Finished surface grades; and

(f) Identification number/letter.

These details must be provided to the certifying authority prior to the issue of a Construction Certificate

4.5.3 Topsoiling

All disturbed areas are to be topsoiled and seeded in accordance with Council's **Engineering Construction Specification**.

4.5.4 Drainage

Where, due to the regrading of the land, the free flow of roof and/or natural surface water is obstructed or concentrated, then an adequate stormwater drain shall be provided to intercept and convey these waters to the nearest adequate Council stormwater drain or natural watercourse.

4.5.5 Flood Prone Land

The minimum regraded level for land to be used for residential, commercial and industrial development is to be 0.5 metres above the 1% AEP flood level at the site..

4.5.6 Existing Dams and Watercourses

Where existing dams or watercourses occur a geotechnical report shall be prepared by a suitably qualified Geotechnical Engineer, certifying engineer detailing any necessary works. The certifying engineer shall have a Level 1 responsibility in accordance with **AS 3798**.

Any filling must be undertaken in such a manner such that the drainage pattern is not altered in a way that would affect the adjoining properties.

4.5.7 Retaining Walls

All retaining walls must be designed and certified by a suitably qualified Structural Engineer. Retaining walls shall incorporate any necessary easements for support and maintenance and be designed to transfer any loads so that no adjoining easement, public road/reserve or property is burdened or restricted by the presence of the retaining wall.

Adequate provisions must be made for surface and subsurface drainage. Any water collected shall be diverted to, and connected to a stormwater pit.

4.5.8 Geotechnical Report

Depending on the regrading works, Council may require a geotechnical consultant to prepare a report. The report must cover, but not be limited to:

(a) Extent and stability of proposed embankments (particularly those acting as retarding basins);

(b) Recommended geotechnical testing requirements;

(c) Compaction specification for all fill within private subdivisions;

(d) The level of risk to existing adjacent dwellings as a result of a construction contractor using vibratory rollers anywhere within the site the subject of these works. In the event that vibratory rollers could affect adjacent dwellings, high risk areas must be identified on a plan and the engineering plans must be amended to indicate that no vibratory roller must be used within that zone;

(e) The impact of the installation of services on overall site stability and recommendations on short term drainage methods, shoring requirements and other remedial measures that may be appropriate during installation;

(f) The preferred treatment of any unstable areas within privately owned allotments;

(g) Requirement for sub-surface drainage lines; and

(h) Overall suitability of the engineering plans for the proposed development.

4.6 TRAFFIC MANAGEMENT

4.6.1 Traffic Management Plans

A 'Traffic Management Plan' shall be prepared at a minimum scale of 1:1000 detailing traffic management measures required for construction traffic, staged construction and ultimate conditions. Where required by Council a full traffic management report shall be included with the submitted Engineering Plans detailing any required traffic management measures. Traffic Management Plans and reports, must be prepared by a suitably qualified RMS accredited traffic designer.

To address public safety from a criminal standpoint all traffic management structures and system elements must be assessed using the NSW Police **'Safer by Design'** or **Crime Prevention through Environmental Design (CPTED) principles and protocols**. The development proposal must demonstrate how public safety and risk will be managed. The following will be considered in the assessment of proposals (this list is not exhaustive and requirements will vary from site to site):

(a) System elements which provide concealment opportunities will not be permitted; and

(b) Vegetation which provides opportunities for concealment adjoining pedestrian areas will not be permitted.

All traffic control facilities and prescribed traffic controls devices including regulatory signage and line-marking are subject to the concurrence of the Camden Council Local Traffic Committee.

4.6.2 Traffic Control Plans

A Traffic Control Plan must be prepared by a suitably qualified RMS accredited work site traffic designer for all works that are carried out in or adjacent to a public road and will impact on vehicular or pedestrian movements. The 'Traffic Control Plan' must satisfy all the requirements of **AS 1742.3** with reference to the **RMS 'Traffic Control at Worksites Manual'.**

It is the sole responsibility of the applicant to have in place and maintain traffic facilities, i.e., barricades, signs, lights, etc, at all times, day and night, 7 days a week for the duration of the works in accordance with the Plan.

These traffic facilities must be installed and maintained by appropriately qualified RMS accredited work site traffic controllers.

All and any responsibility will rest with the applicant who must absolve Council and its employees from any suit of law which may result from the failure of the applicant to comply with the above requirements.

If it comes to the attention of Council that Traffic Control Devices are insufficient or inoperable (particularly in an after-hours situation), then Council may arrange to reinstate the Traffic Control Devices and recoup the costs from the applicant.

Any changes to the approved Traffic Control Plan must be approved by the original RMS accredited work site traffic designer before implementation.

The applicant is to ensure that the approved Traffic Control Plan is submitted to Council at least ten (10) working days before any works are undertaken on any existing public assets owned, maintained or controlled by Council.

Where works are to be carried out on a Council road, a Road Opening Permit and Roads Act Approval must be obtained from Council and an appropriate fee paid prior to any works being undertaken. Council must be notified the day before the works are to take place.

Where works are to be carried out on a State road, or within a 100m of a signalised interesection or the works will affect traffic within a state road a Road Occupancy License, a Road Opening Permit and Roads Act Approval must be obtained from the RMS prior to any works being undertaken.

4.6.3 Traffic Control Facilities and Prescribed Traffic Control Devices

The contractor shall provide and install any necessary traffic control facilities or/and prescribed traffic control devices as required by the Council or/and RMS. The concurrence of the Camden Council Local Traffic Committee shall be obtained prior to the installation of any traffic control facilities or/and prescribed traffic control devices on existing roads (including on existing roundabouts, slow points and regulatory signs including parking restrictions).

Specific Traffic Control Devices (e.g. roundabouts, thresholds etc.) shall be designed in accordance with **'Austroads Revision of Guide to traffic Engineering Practice Part 8 : Traffic Control devices'** and **RMS Supplements to AUSTROADS Guides** which is detailed below:

(a) Part 1 Introduction to Traffic Management (2009);

(b) Part 2 Traffic Theory (2008);

(c) Part 3 Traffic Studies and Analysis (2013);

(d) Part 4 Network Management (2009);

(e) Part 5 Road Management (2008);

(f) Part 6 Intersections, Interchanges and Crossings (2013);

(g) Part 7 Traffic Management in Activity Centres (2009);

(h) Part 8 Local Area Traffic Management (2008);

(i) Part 9 Traffic Operations (2009);

(j) Part 10 Traffic Control and Communication devices (2009);

(k) Part 11 Parking (2009);

(l) Part 12 Traffic Impacts of Development (2009); and

(m) Part 13 Road Environment Safety (2009).

Notwithstanding the guidelines presented above, the provision of traffic control devices should generally consider and cater for the following:

(a) Design vehicle turning paths;

(b) Pedestrians and cyclists;

(c) Drainage;

(d) Street lighting;

(e) Sight distance;

(f) Signposting and pavement marking;

(g) Emergency vehicles;

(h) Private accesses; and

(i) Landscaping and street scaping.

AUSTROADS has released the Guide to Traffic Management and all road agencies across Australasia have agreed to adopt the **AUSTROADS** guides to provide a level of consistency and harmonisation across all jurisdictions. This agreement means that the new **AUSTROADS** guides and the Australian Standards, which are referenced in them, will become the primary technical references for use within the RMS. This supplement is issued to clarify, add to, or modify the **AUSTROADS** '**AGTM Austroads Guide to Traffic Management**'.

The RMS accepts the principles in the **AUSTROADS** '**AGTM Austroads Guide to Traffic Management**' with variations documented in this supplement under the following categories:

(a) RMS Enhanced Practice: RMS practices which enhance the **AUSTROADS** Guidelines;

(b) RMS Complementary Material: RMS traffic reference material that complements the **AUSTROADS** Guidelines. These documents include RMS Manuals, Technical Directions and/or other reference material and are to be read in conjunction with the **AUSTROADS** Guidelines; and

(c) RMS Departures: RMS Traffic Practices that depart from the **AUSTROADS** Guidelines.

If there are any differences in practice between the RMS supplements and other RMS complementary material, **the RMS supplements will apply**.

4.6.4 Street Lighting

4.6.4.1 General

In general, Council requires lighting levels to be applied in accordance with **AS/NZS 1158.0**.

To address public safety from a criminal standpoint street lighting must be assessed using the NSW Police **'Safer by Design'** or **Crime Prevention through Environmental Design (CPTED) principles and protocols**. The development proposal must demonstrate how public safety and risk will be managed.

Reference shall be made to Council's DCP and Camden Council's public domain manual for further information about specific styles, types and colours of street lighting applicable in the Camden Council LGA.

Generally a galvanised finish for all street poles (lighting and signage) is required for all areas of the Camden Council LGA, special consideration will be given for the use of coloured or painted street lighting poles in civic and community areas with the approval of **Council's Engineer**.

4.6.4.2 Approval of Proposed Schemes

The appropriate levels for street lighting need to be identified by Council. In order for this to be identified, proposed schemes showing the limits of the works, proposed traffic management devices and other relevant information are to be forwarded to Council so that an accurate assessment can be undertaken to ensure compliance with **Council's Street Lighting Guidelines** and **AS/NZS 1158.0** in its various parts. The appropriate street lighting categories will be forwarded to the applicant by way of a Design Brief Checklist to enable street lighting designs to be prepared for Council's approval and acceptance.

To further assist the designer, designs should also be prepared in line with Endeavour Energy document SPJ 4004 Network Connections Contestable Works General Terms and Conditions 'Section 6 - Public Lighting Assets'. Where street lighting is to be provided within the central median islands, barrier kerb is to be provided.

4.6.4.3 Arterial Roads and Sub-Arterial Roads

The lighting of arterial and sub-arterial (Traffic Route Lighting) roads must comply with **AS/NZS 1158.1.1** and using the appropriate lighting categories.

4.6.4.4 Residential Roads and Public Places

The Lighting of residential roads and public places must comply with **AS/NZS 1158.3.1** and using the appropriate lighting categories.

4.6.4.5 Rural Roads

Due to the low development density and low pedestrian activity, there is no specific standard for rural roads. 'Flag' lighting is generally required to illuminate intersections, bends and cul-de-sacs so that motorists are made aware of specific road hazards by highlighting them with a single street light.

4.6.4.6 Subdivisions

The lighting of subdivisions must comply with the following:

(a) For residential roads in areas having underground reticulation of electricity the basic lighting category should normally be P4 – this implies utilizing columns at about 55 metre spacing;

(b) For 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 a region to another part the minimum lighting requirement should be either V5 or P4 and in accordance with the standard;

(c) Compliance with Endeavour Energy document General Terms and Conditions for the Connection of Public Lighting Assets; and

(d) The determination of lighting category's for roads will be at the discretion of Council and applied generally in accordance with **AS 1158.0**.

(e) Street lighting poles are detailed in Camden Council's '**Landscape and streetscape Elements Manual (2006)**' and list specific types, sizes and colours applicable in the Camden Council LGA

4.6.4.7 Traffic Management Devices

Lighting of Traffic Management Devices is to be provided generally in accordance with **AS/NZS 1158.0** and as determined by Council.

4.6.4.8 Energy Efficiency

Street lighting designs are required to achieve an objective of energy efficiency.

4.6.5 Signs and Stencilling

4.6.5.1 Street Signs

Street signs are to be manufactured and installed at all street intersections, unless otherwise directed by Council. Street signs shall be replaced or repaired by the developer for the twelve month maintenance period, following registration (in the case of a subdivision) or the release of the Occupation Certificate (in the case of other development).

The street name and colour of sign are to be ascertained from Council and the sign location is to be shown on the engineering drawings. Reference is to be made to Camden Council's '**Landscape and streetscape Elements Manual (2006)'** for specific types, sizes, colours and fonts of street signs applicable in the Camden Council LGA.

4.6.5.2 Lot Number and Street Name Stencilling

Lot numbers are to be stencilled on the kerb face for all new developments.

Reference is to be made to Council's DCP for further details on specific stencil types, sizes, colours and fonts applicable in the Camden Council LGA.

4.6.6 Guide Posts and Protection Fencing

Guide posts and protecting fencing are to be provided where required in accordance with RMS forms:

(a) **RMS Specification 3411** 'Supply of Guide Posts (Timber)';

(b) **RMS Specification 3412** 'Supply of Guide Posts (Non-timber)';

(c) **RMS Specification R131** 'Guide Posts';

(d) **RMS Specification R132** 'Safety Barrier Systems'; and

(e) **RMS Specification R201** 'Fencing'.

4.6.7 Sign Posting and Pavement Markings

Sign posting, raised pavement markers and pavement markings are to be provided to roads, intersections, traffic control devices, cycleways and car parks in accordance with **AS 1742.1** , '**RTA Supplement to Australian Standard 1742**' and the '**RTA Delineation'** Guidelines and **RMS Signs Database**.

All line marking must be thermo-plastic reflective, unless approved in writing by Camden Council.

4.6.8 Traffic Signal

Traffic signals are not delegated to Council. The applicant shall make direct contact with RMS – Traffic Signal Management Unit for assessment and approval of traffic signals.

4.6.9 Parking Plan

Where require by the nature of the development, parking plans shall be submitted at an appropriate scale. The parking plans shall conform to the requirements set out in Councils relevant DCPs.

4.7 OTHER MANAGEMENT PLANS

4.7.1 Environmental Management Plan

An environmental management plan (EMP) is site or project specific plan developed to ensure that appropriate environmental management practices are followed during a project's construction and/or operation. An effective EMP should ensure application of best practice environmental management, compliance with environmental legislation and that environmental risks associated with a project are properly managed.

The EMP shall address the manner in which site operations are to be conducted and monitored to ensure that adjoining landuses and the natural environment is not unacceptably impacted upon by the proposal. It shall include, but not necessarily be limited to, the following:

a) Measures to control noise emissions from the site;

b) Measures to suppress odours and dust emissions;

c) Soil and sediment control measures;

d) Measures to control air emissions that includes odour;

e) Measures and procedures for the removal of hazardous materials that includes waste and their disposal;

f) Any other recognised environmental impact; and

g) Community Consultation.

4.7.2 Construction Management Plan

When proposing construction, particularly on sites with restricted access, a construction management

plan (CMP) may be required. CMPs will be assessed on an individual basis and the amount of detail required will depend on the type of development and area in which it is located. The objective of the CMP is to minimise the impact of construction activities of neighbours, surrounding streets and places.

A CMP may include the following construction management matters:

a) Construction traffic

b) Construction waste

c) Construction noise

d) Any combination of the above.

A CMP shall address the following requirements where they are relevant to the development for Construction, demolition and excavation works:

4.7.1.1 Construction Traffic Management

Shall address the following:

a) Describe the anticipated impact of the construction works on local traffic routes, pedestrian circulation and on-street parking;

b) Describe the means proposed to manage construction works to minimise such impacts;

c) Show the location of any proposed Works Zone (or Construction Zone), site sheds, structures to be erected such as hoardings, scaffolding or shoring;

d) Describe the excavation impact on the area (including number and types of trucks to be used, time frame, streets and routes to be used;

e) Tree Protection (Exclusion) Zones.

Shall include the following requirements/ controls:

a) No spoil, building materials, excavated or demolition material from the site shall be stored or deposited on the public road, footpath, public place or Council owned property, without prior approval of Council.

b) Any work and public utility relocation within a public place shall incur no cost to Council.

c) During demolition, public property (footpaths, roads, reserves, etc.) shall be clear at all times and shall not be obstructed by any demolished material or vehicles. The footpaths and roads shall be swept (not hosed) clean of any material, including clay, soil and sand. On the spot fines may be levied by Council against the demolisher and/or site owner for failure to comply with this condition.

d) All vehicles leaving the site with demolition materials shall have their loads covered; vehicles shall not track soil and other materials onto public property (footpaths, roads, reserves, etc.); and all footpaths shall be suitably protected against damage when plant and vehicles access the site.

e) Delivery Register – a register of deliveries of fill, which includes date, time, truck registration number, quantity of fill, origin of fill and type of fill delivered. (This register is to be made available to Council Officer's.)

4.7.1.2 Construction Waste Management

Describes the measures that the contractor will utilise to identify the waste streams and tailor work activities to minimise the generation of waste and manage it appropriately at the site, and shall address the following:

a) Estimated quantities of materials that are reused, recycled, removed from the site;

b) Identification of the location and facilities for on-site material storage areas during construction;

c) Identification of the location and facilities for the collection and disposal of waste generated within the premises;

d) Materials and methods used during construction to minimise waste;

e) Nomination of end location of all waste generated.

4.7.1.3 Construction Noise Management

Describes the measures and management procedures to be implemented to manage construction noise (and vibration) levels during site works, associated with site workers, the surrounding community and infrastructure. This plan shall be prepared by a qualified acoustic consultant and include the following:

a) Identification of sensitive locations near the site;

b) Identification of potential impacts including exceedence of the goals at the identified locations;

c) Mitigation measures to control noise, noise reduction and feasibility and reasonableness of these measures;

d) Selection criteria for plant and equipment;

e) Community consultation;

f) Details of work schedules for all construction phases;

g) Selection of traffic routes to minimise residential noise intrusion;

h) Schedule of plant and equipment use and maintenance programs;

i) Noise monitoring techniques and method of reporting results;

j) The methodology to be employed for handling and investigating any complaints should they arise;

k) Site induction details for employees and contractors;

l) A declaration or available technologies and the reason for the selection of the preferred technology from a noise generating perspective should be included.

4.7.3 (Demolition) Work Plan

Prior to the commencement of any demolition work, the contractor should develop a Work Plan for the job. The work plan should include the identification and assessment of hazards and the control measures to be implemented to address these hazards. Guidance on developing a Demolition) Work Plan can be found in **AS 2601**.

SECTION 5 – LANDSCAPING

5.1 GENERAL

This Specification provides landscaping procedural advice and landscaping design advice for open space and public open space areas within the Camden LGA, including environmental, recreational, cultural, structural and ornamental landscaping.

5.2 DESIGN GUIDELINES

5.2.1 Public Open Space

Public open space generally refers to all land that Council has the ongoing care and maintenance responsibility. This can apply to areas of both passive and active recreation including road verges, nature strips, parks, reserves, rehabilitation areas, revegetation areas, riparian areas, conservation areas, drainage channels and sports fields and complexes etc.

The care and maintenance responsibility of public open space areas within subdivisions and other developments is normally handed over to Council at the completion of the Development sites maintenance and establishment period for the Landscaping works. The standard maintenance and establishment period for the developer is 12 months from the practical date of completion of the landscaping works in accordance with an agreed maintenance schedule and landscape plan, or as otherwise agreed by Council.

However, prior to Council accepting the care and maintenance responsibility for the public open space areas from the developer, all hard and soft landscaping elements (e.g. street trees, grasses, street tree protective guards, root barrier and bollards), must be in an undamaged, safe and functional condition. All plantings must have signs of successful establishment as well as healthy and vigorous growth.

5.2.2 Sporting Fields, Parks, Reserves and Other Substantial Public Open Space Areas

(a) The developer shall be responsible for the installation costs involved with the placement of adequate separate water and power meter as per the intended use of the subject site. The water and power meters will act alone from other metered services adjoining the site;

(b) During their maintenance and establishment period, the developer shall be responsible for all irrigation costs of the subject site;

(c) The developer shall be responsible for all electrical costs during their maintenance and establishment period relevant to the public open space site;

(d) Sufficient irrigation and drinking water outlets shall be provided by the developer at regional and district parks, reserves and sports grounds to the satisfaction of Council;

(e) Irrigation outlets and drinking water outlets may be required from the developer for some local and other minor parks and reserves to the satisfaction of Council;

(f) Large trees and large spreading shrubs shall not be planted within 3 metres of any pathway or cycleway in public open space areas. Consideration shall be given to access by emergency and maintenance vehicles in many instances;

(g) Trees, tall native grasses and large spreading shrubs shall not be planted within 10 metres from road intersections. Nature strips and road verge areas shall have a soft (lawn) or hard (paving/concrete) surface within these areas;

(h) Trees and shrubs shall not be planted close to car parking spaces or bays in public open space such that the planting would obstruct the opening of doors or safe manoeuvring of vehicles;

(i) Strappy leaf native grasses shall not be planted within 1 metre of any pathway or cycleway in public open space areas;

(j) Any space between the edge of a path and the roadside kerb, that is less than 1m in width, shall have lawn laid instead of native grasses as the landscaping;

(k) Areas in public open spaces that will require mowing, repair, litter and weed control should be a maximum gradient of 1(V):6 (H) to enable safe, efficient and effective maintenance, furthermore it must have a minimum 3 metres separation from live traffic in accordance with Workcover requirements;

(l) Lighting may be required in accordance with the **CPTED** requirements, and energy saving lamps shall be used and timer switches are to be utilised for turning lights off after certain time when the park is not expected to be used at night to the satisfaction of Council;

(m) All proposed structures, cycleways and paths within public open space are subject to relevant standards and codes and shall require approval and subsequent inspection by the Certifying Authority. Such items also include gazebos, shelters, bridges, electric BBQ's, etc;

(n) All structures, cycleways and paths shall be designed to address public safety using the NSW Police **'Safer by Design'** or **CPTED** guidelines; and

(o) All proposed furniture and public art installations for any street, reserve, park or other public open space area, shall be detailed in all Landscaping Plans to the satisfaction of Council.

5.2.3 Mounding within Public Open Space areas[(1)]

A maximum gradient of 1(V):6(H) for all types of mounding in public open space is preferred by Council for a safer maintenance environment and a more manageable and effective growing environment.

The absolute minimum requirement for mounding within any public open space is:

(a) at a maximum gradient of 1(V):4(H).

[(1)] Note: This section also applies to mounding used for acoustic barrier purposes.

5.2.4 Landscaping Plans

Landscaping Plans, prepared by a qualified Landscape Architect qualified Ecologist or qualified Landscape Designer, must be submitted with the Development Application, in accordance with Camden Council's current Engineering Design Specifications.

The following details must be included in the Landscaping Plans:

(a) All hard and soft landscaping elements in any proposed public open space;

(b) All proposed recreational park landscaping and any proposed recreational or playground equipment, street and park furniture, retaining walls, street lights, ground levels, universal access, access path gradients, proposed signage at (park name at regulatory signs at park entrances), paths, bins, seating, public art or other hard landscaping items, to the satisfaction of Council;

(c) All trees and other vegetation proposed to be removed and trees and vegetation that are proposed to be retained;

(d) A planting schedule (reference should be made to Council's Planting List).

(e) The following elements:

  (i) That the tree selected can stand alone as a feature tree;

  (ii) Power/Gas/Water/Sewer/Cable lines;

  (iii) Street Lights, powerlines and other above ground services;

  (iv) Pruning and shaping resilience of trees;

  (v) Easements, cycle ways and paths;

  (vi) Provide essential shade and upper canopy;

(vii) Driveways and bus stops;

(viii) Pedestrian crossings;

(ix) Lot frontage width and house setbacks;

(x) Lateral spreading habits of trees;

(xi) Road verge and nature strip widths;

(xii) Waste service collections;

(xiii) Vehicle vision and other safety view lines; and

(xiv) Cultural and heritage amenity of the area or street.

The Landscaping Plans must clearly display if the design is only conceptual or is detailed enough for the Construction Certificate issue. A revision number, issue number and issue date shall also be clearly displayed on the Plans.

The Landscaping Plans shall be prepared by a qualified Landscape Architect, qualified Ecologist or qualified Landscape Designer. Landscape Plans are required to be submitted with the Development Application.

5.2.5 Road Areas

Any landscaping within road reserves (e.g. median strips, roundabouts, verges), must be designed and installed with regards future maintenance of the landscaping and to the satisfaction of Council.

5.3 CONSTRUCTION GUIDELINES

5.3.1 Clearing of Existing Trees and other Vegetation

Approval advice and information must be sought from Council prior to any removal, pruning, impact upon or disturbance of any existing trees, landscape feature or other vegetation within the Camden Local Government Area.

Landscaping Plans for any proposed development must clearly detail that the protection of existing trees and other landscape features, other than any existing trees and natural landscape features authorised for removal, pruning, impact upon or disturbance, will be carried out as specified in **AS 4970**.

All initial procedures for the protection of existing trees and landscape features, as detailed in **AS 4970**, must be installed prior to the commencement of any earthworks, demolition, excavation or construction works on the development site.

The works and procedures involved with the protection of existing trees and other landscape features are to be carried out by suitably qualified and experienced persons or organisations. This work should only be carried out by a fully insured and qualified Arborist.

Suitable qualifications for an Arborist are to be a minimum standard of Australian Qualification Framework (AQF) Level 3 in Arboriculture for the actual carrying out of tree works, and Australian Qualification Framework (AQF) Level 3 in Arboriculture for the preparation of Preliminary Site Assessment, Development Impact Assessments, Tree Protection Plans, Tree Health Assessments and Tree Risk Assessments.

5.3.2 Trees and Shrubs

The Landscaping Plans must include a planting schedule.

The planting schedule must clearly detail the planting positioning, species by botanical and common names, quantities, planting sizes and the estimated size of the plant at approximately 12 years maturity.

The planting schedule must also detail the proposed establishment and maintenance programme.

The Landscaping Plans must demonstrate that the existing cultural and heritage amenity (where relevant), as well as any existing surrounding trees and ecological communities, have been a consideration in the preparation of the proposed planting schedule for the development site.

The contractor shall supply and plant trees and shrubs of the types detailed on the approved Landscaping plans. Trees and shrubs shall be planted in the locations shown on the Landscaping Plans. Root barriers to the kerb and concrete paths/cycleways are required in new or existing roadway construction.

After installing the trees and shrubs, the developer shall ensure that sufficient watering, care and repair is carried out to sustain the new plantings' throughout the maintenance and establishment period.

Installation of new street trees or the protection of existing street trees shall;

(a) Ensure that the necessary street tree installation and their proposed establishment schedules are clearly shown in the Landscaping Plans.

(b) All street trees at time of planting must have well constructed tree guard protection installed. Bollards are considered acceptable as one form of tree guard. If bollards are used then they are to be in minimum 1.8 metre lengths, which will allow for 1.2 metre above ground exposure and 0.6 metre buried support. Bollards are to be a minimum 150 mm x 150 mm width. If timber bollards are to be used then they need to have a minimum durability of H4 CCA.

(c) Very large trees such as Eucalyptus, Angophora, Araucaria etc should not be designed into any road median, nature strip or road verge unless agreement to install these very large spreading and growing tree types is first sought from the Consent Authority.

(d) That all the street trees are sourced in a minimum 45 litre container size, are not multi-stemmed and can stand alone without the need for staking.

(e) Street trees spacing of 18 metres apart (from main stem to main stem) should be considered as a standard guide for installation numbers requirements.

(f) Street trees are to have root barrier controls to the kerb and other essential infrastructure (e.g. concrete paths) as well as a minimum 750 mm distance between trees and concrete paths/cycleways is to be provided where possible.

SECTION 6 – DESIGN DRAWINGS

6.1 STRUCTURAL DRAWINGS

Where required by Council, structural drawings of any building or structure shall be submitted at an appropriate scale.

The design and specification for all load carrying structures shall be prepared by a suitably experienced person and certified on the plans by a suitably qualified Structural engineer, that the structure has been designed to Australian Standards. Upon completion of the work, a suitably qualified engineer must certify that the work has been constructed in accordance with the approved plans.

Where a retaining wall exceeding 600 mm in height is to be constructed the design shall be carried out by an experienced person and certified on the plans by a suitably qualified Structural engineer and submitted to Council.

6.2 OTHER STRUCTURES

Where required plans of other structures e.g. dams, shall be submitted at an appropriate scale.

APPENDIX A – CHECKLIST FOR ENGINEERING PLANS

The following checklist is provided as a guide to ensuring that submissions are complete. The checklist is to be certified by the applicant and submitted as part of the Construction Certificate application.

		YES	NO
A.1	**General**		
(a)	All work to CC specification.		
(b)	Construction Certificate fee paid.		
(c)	DA Consent issued.		
	Road layout, lot layout, building layout, road reserve widths, carriageway widths, pathway widths, car parking layout and landscape areas comply with approved plans – attached to Development Consent.		
(d)	All DA conditions complied with.		
(e)	Landscape plan for public reserves included.		
(f)	Long Service Levy		
A.2	**Cover Sheet**		
(a)	Locality plan (if required).		
(b)	Index of drawings sheets.		
(c)	Legend.		
A.3	**Layout Plans**		
(a)	Benchmarks and datum shown.		
(b)	Scale, existing contours/levels (0.5 metre interval), final contours, north point.		
(c)	Limits of construction shown (Permit to enter included if work on adjoining property).		
(d)	Lots numbered, roads named/numbered, drainage lines & pits numbered.		
(e)	Path paving strategy including barriers and pram ramps at intersections.		
(f)	Existing utilities and services shown.		
(g)	Extent of significant earthworks, cut/fill batters.		
(h)	Significant trees (greater than 100 mm diameter) and other environmental features affected by the development are clearly indicated and annotated.		
(i)	Existing public and private property likely to be affected by this application are clearly indicated and annotated.		
(j)	Drainage structure/schedule		
(k)	Development Application No		
(l)	Standard Notes included		
A.4	**Environmental Site Management**		
(a)	Measures outlined in the ESCP implemented prior to and maintained during and after the construction works.		
(b)	All disturbed areas and stockpiles to be stabilised within 14 days.		

		YES	NO
(c)	Diversion drains to take clean water around site - check velocity for scour.		
(d)	Phasing schedule included.		
(e)	No disturbance outside site and minimising disturbance to grass cover internally.		
(f)	No trees to be removed without Council consent.		
(g)	Truck shaker and fencing to control access.		
(h)	Topsoil to be stockpiled and re-used.		
(i)	Stockpiles – max 2 metres high with silt fence, catch drain and temporary vegetation if in place longer than 2 months.		
(j)	Sediment basins at downstream discharge point, not online.		
(k)	Catch drains to divert dirty water to basin.		
(l)	Silt fences – max 0.6 ha, max 60 metre flow, max 1(V):2(H) slope.		
(m)	Silt barriers to all stormwater pits to block sediment during construction.		
(n)	Dust control by watering and progressive early revegetation.		

A.5 Road Design

(a)	Vertical Grading in accordance with this specification.		
(b)	Length of VC's appropriate.		
(c)	Road cross sections provided.		
(d)	Road longitudinal sections provided.		
(e)	Intersection/ cul-de-sac and kerb profiles provided if required.		
(f)	Roundabout design provided if required.		
(g)	Bridge design provided if required		
(h)	Road and footpath crossfalls shown.		
(i)	Road category and classification.		
(j)	Check dimensions for conformity with the Road Hierarchy.		
(k)	Pedestrian, bicycle and parking requirements met.		
(l)	Footpath, cycleway and pathway widths and locations shown.		
(m)	Extent of cut/fill to generally follow existing surface levels, 1(V):6(H) batters for access.		
(n)	No ponding on lots where filling at boundary line.		
(o)	Kerb type shown.		
(p)	Kerb return radii (9 metre, 12 metre Rural and Industrial)		
(q)	Kerb return longitudinal sections to an appropriate scale as provided in Section 1.8.2 (1:200, 0.1 metre contour interval).		
(r)	Low points drained (including around kerb returns)		
(s)	Splay corners (4 metre x 4 metre Urban, 12 metre x 12 metre Industrial).		
(t)	Chainages, tangent points and bearings shown.		
(u)	Cul-de-sac radii.		
(v)	Footpath width and utility/service corridor maintained in cul-de-sacs.		
(w)	Temporary sealed turning circles with guideposts at end of staged / future roads.		
(x)	12.5 metre Heavy Rigid Truck able to turn in meandering pavements and hammerheads, etc.		
(y)	Vehicle crossings specified in accordance with Consent.		
(z)	Vehicle crossings to have minimum 1 metre clearance from power		

		YES	NO
	poles and pits.		
(aa)	Heavy duty crossings provided where specified in consent.		
(bb)	Check vehicles crossings do not clash with drainage pits.		
(cc)	Lipless Perambulator ramps to be provide at pathways and all kerb returns.		
(dd)	Bus bays to be provided at school site.		
(ee)	Pavement detail to be designed by a suitably qualified Geotechnical engineer.		
(ff)	Thresholds – pavers on concrete designed to Cement, Concrete and Aggregates Assoc guidelines.		
(gg)	Subsoil drainage on both sides of road and in medians.		
(hh)	Utility adjustments at applicant's expense.		
(ii)	Conduits to be placed where required by the relevant authorities.		
(jj)	Smooth junction with all existing work.		
(kk)	Road related structures assessed using the principles of **CPTED**.		

A.6 Drainage Design

(a)	Drainage longitudinal sections provided.		
(b)	1% AEP overland flow path - footpaths warped where required		
(c)	Each lot drained - provision for lots where edge strip only provided.		
(d)	No overland flow from roads or reserves onto private land		
(e)	Interallotment Drainage Lines – minimum 150 mm diameter pipe		
	- Minimum grade of 1.0%		
	- Hydraulic capacity, grade and cover in accordance with **AS 3500.3**.		
	- Intervals not more than 75 metres between inspection pits.		
	- Overland flowpath formed to provide stormwater escape route.		
	- Minimum 1.5 metre wide interallotment drainage easement.		
	- Maximum eight (8) dwellings served.		
(f)	Easement required where pipes traverse Council land.		
(g)	Catchment plan including upstream areas, check areas.		
(h)	Hydrology/hydraulic calculations n* = 0.08, max T_c = 15 mins.		
(i)	Tabulated stormwater drainage calculation sheet including:		
	- Q_5 Urban, Q10 industrial.		
	- Sub-catchment areas.		
	- Velocity x depth < 0.4 m/s.		
	- Maximum pit spacing 75 metres.		
	- Hydraulic grade line analysis.		
	- Velocities (0.6 m/s to 6.0 m/s).		
	- K factor adopted (or 'n' value).		
	- Surface roughness coefficients adopted.		
	- Head losses		
	- No trapped low points allowed.		
	- Check ponding depth at sag pits.		
	- Actual pit bypass provided.		

		YES	NO
	- Gutter flow analysis.		
	- Minimum Class 2 pipes under roads.		
	- Check for ponding on lots.		
(j)	Electronic copies of computer input and output data files for all hydrological, hydraulic and water quality models submitted, together with accompanying catchment and layout plans.		
(k)	5% AEP, 1% AEP and PMF flood lines to be identified on design plans for both mainstream channelling and overland flow paths,		
(l)	Hydraulics - HGL plotted on longitudinal section, minimum 150 mm freeboard at pits, K values calculated.		
(m)	Pipe size and class.		
(n)	Pipe type - RRJ Concrete (min 375 mm) in roads, PVC sewer grade (in trafficable areas).		
(o)	Backfill to be washed river sand or gravel full depth in trafficable areas and 150 mm above pipe in landscape areas.		
(p)	Minimum pipe cover of 0.6 metres provided at the collar.		
(q)	Pipe grades – minimum 1%.		
(r)	Anchor blocks over 15%.		
(s)	Radius of any curves to manufacturer's specifications, generally greater than 100 metres for 375 mm.		
(t)	Ensure utility/service locations are shown on longitudinal section and do not clash with pipelines.		
(u)	Pit type & lintel size on pit schedule- generally minimum 1.2 metres for gully pits on grade, 2.4 metre for sags pits.		
(v)	Ensure pit location does not clash with vehicle crossings.		
(w)	Pits clear of stencilled/paved thresholds.		
(x)	Subsoil drainage has been provided as required.		
(y)	Step irons and reinforcement for pits deeper than 1.2 metres and 1.5 respectively as measured from the top of the kerb, to the invert of the pit.		
(z)	Structural details for irregular pits and structures or where depth exceeds 2.0 metres.		
(aa)	Outlet conditions detailed and provided for.		
(bb)	Tailout batters safe and not concentrating flow on adjoining property.		
(cc)	All channels, open drains etc, note to turf.		
(dd)	Open channels to have maximum 1(V):4(H) batters for maintenance.		
(ee)	Scour protection at headwalls and in open channels/swales.		
(ff)	Drainage structures and flow paths are located so as to ensure safe vehicular and pedestrian transit.		
(gg)	WSUD elements are detailed with supporting documentation.		
(hh)	Water quality treatment has been incorporated where required.		

A.7 Traffic Management

(a)	Traffic Management Plan provided.		
(b)	Parking Plan provided if required.		
(c)	Temporary fencing & barriers for construction.		
(d)	Traffic signs and street signs to Council's requirements.		
(e)	Street lighting to Council's requirements.		
(f)	Linemarking, raised pavement markers and chevrons at Roundabouts.		

APPENDIX B – LIST OF STANDARD DRAWINGS

Table B.1 includes a list of standard drawings that are to be read in conjunction with this Specification.

Table B.1 List of Standard Drawings

STANDARD DRAWING NUMBER	TITLE	ISSUE DATE
SD01	Typical Road Cross Sections	Jan 2009
SD02	Kerb Profiles	Jan 2009
SD03	Kerb Ramp	Jan 2009
SD04	Footpath Details	November 2017
SD05	Cycleway/Shareway Details	November 2017
SD06	Pathway Rails	Jan 2009
SD12	Grated Gully Pit	Jan 2009
SD13	Surface Inlet Pit	Jan 2009
SD14	Junction Pit	Jan 2009
SD16	Surcharge Pit	Jan 2009
SD17	Minor Drainage Connections	Jan 2009
SD20	Step Irons	Jan 2009
SD21	Single Pipe Headwall	Feb 2017
SD26	Kerb Adaptor	Jan 2009
SD27	Street Name Signage	Jan 2009
SD28	Flood Warning Signage	Jan 2009
SD30	Rock Retaining Wall	Jan 2009
SD31	Stabilised Access Point	Jan 2009