Guidelines for Civil Engineering Design and Construction for Development

FEBRUARY 2012

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AMENDMENT RECORD

Proposals for amendment or addition to the contents of this manual are to be forwarded in writing to:

Group Manager of Operations
Lithgow City Council
PO Box 19
180 Mort Street,
LITHGOW NSW 2790

Amendments promulgated should be certified in the following table when entered into the manual.

Amendment			**Entered**
No.	Date	Description	Name

Section 1.0 GENERAL

1.0 INTRODUCTION

These Guidelines for Civil Engineering Design and Construction have been developed to provide consistent guidelines for the design of engineering works within the Lithgow City Council Local Government Area, and facilitate the expeditious processing of engineering plan submissions, construction approvals, and linen plan releases for subdivisions and developments.

Council welcomes the submission of innovative design solutions which vary from the provisions contained within these guidelines, and will consider these proposals on their merits, having regard to such matters as the infrastructure design life and long-term maintenance requirements.

Applicants should be aware that all development applications are considered on the merits of the development and its overall impact on the area, and not solely in compliance with minimum engineering standards. It is imperative that all conditions of development consent imposed under the Environmental Planning and Assessment Act are addressed within the detailed engineering plans, as these conditions take precedence over the information contained herein.

When development approval includes conditions of construction which are embodied in the approved plans and specifications, the onus is on the applicant to whom the approval is given to ensure works are carried out in compliance with these conditions.

Council will hold the applicant, to whom the development approval was issued, solely responsible for constructing the approved infrastructure works and maintaining them for the duration of any maintenance period. Any contractor carrying out subdivision or development works is directly responsible to the developer, and not to Council.

DEFINITIONS

Throughout these guidelines, the following definitions and interpretations are adopted:

Applicant / Developer	refers to the person seeking development approval
Bluebook	Formally known as "Managing Urban Stormwater (MUS): Soils and Construction", but more commonly referred to as the "bluebook" publication. The Bluebook is a document produced by the NSW Government to provide guidance for local councils and practitioners for the design, construction and implementation of measures to improve storm water management, primarily erosion and sediment control, during the construction-phase of urban development.
Lithgow City Council	The Local Government body that is responsible for the area known as the Lithgow City Council Local Government Area.
Group Manager of Operations	The Group Manager of Operations at Lithgow City Council, or his nominated representative.
Construction Certificate	Certificate provided by either Group Manager of Operations or Private Certifier, which allows construction of works to proceed.
Council's Development Engineer	Council officer with delegated authority from the Group Manager of Operations to carry out inspections.
Cross Drainage	Drainage used to convey storm water from one side of a road carriageway to the other, nominally at right angles to the road centerline.
Development	Approved works to be carried out by the Applicant.
Development Application	Application for approval to carry out building, engineering or other works as defined in the Local Government Act.
Drawings	Documents presenting information in pictorial form, with or without text, including long sections, elevations, sections and other detail as necessary to fully describe the works to be carried out.
Private Certifier / Engineer	A suitably qualified person, registered on the National Engineers Register 3, engaged by the Applicant to certify that engineering works have been designed and constructed to Council's Engineering Guidelines for Development and Subdivision Works. The Group Manager of Operations may perform the role of the Private Certifier. Note that the private certifier must be independent.
Registered Surveyor	A person registered under the Surveyors Act, 1929, as amended.
SCA	The Sydney Catchment Authority (SCA) is a NSW Government agency that manages and protects Sydney's drinking water catchments & catchment infrastructure.
SCA Area	Information regarding the SCA area can be found in Appendix E.
Specifications	A written document with technical information, directions and conditions which deal with the quality of materials, standard of workmanship and other requirements of a project.
Subdivision	The division, by a land owner, of all or parts of a parcel of land into separate allotments of land, each with a separate title.

1.3 SUBMISSION OF DRAWINGS AND SPECIFICATIONS

1.3.1 Engineering Drawings

The Applicant is required to submit three complete sets of hard-copy Engineering Drawings, and one set of electronic engineering drawings in AutoCAD format to Council prior to the commencement of any development or subdivision site works.
As a minimum, the hard-copy engineering plan submission must include one A1-sized set and two A3 sets of all drawing sheets, and contain the following:

- ***Cover Sheet***
- ***Road Details***
- ***Drainage Details***
- ***Sewerage Infrastructure***
- ***Water Infrastructure***
- ***Electricity, Natural Gas and Telecommunications Plan***
- ***Landscaping Plan (where applicable)***
- ***Erosion & Sediment Control Plan***
- ***Traffic Management Plan***
- ***Certification Report***

One set of the final approved engineering plan sets will be returned to the developer.

For uniformity of plan presentation and to facilitate filing and microfilming, all plan sizes, lettering, linework, and symbols are to conform to the latest edition of Australian Standard 1100 – Technical Drawing.

Each sheet shall include bar scales showing the reduction ratio of all works shown on that sheet, with a ratio scale shown adjacent thereto. All sheets are to be signed by the Consultant / Engineer responsible for the design of the works.

1.3.2 Persons Qualified

Council requires that engineering works be designed to Council standards by a person, either holding qualifications acceptable for Corporate Membership of the Institution of Engineers, Australia, or approved by the Group Manager of Operations, and/or who has proven experience in the preparation of plans and specifications for land development.

1.3.3 Construction Specification

These Guidelines shall in no way be interpreted as being a specification, even though some design criteria are included throughout.

The minimum standards of Construction Specifications to be used are the relevant NSW Roads and Traffic Authority (NSW RTA) construction specifications. However, the developer may submit their own job-specific specifications for approval where there is any variance from these standard specifications.

Two copies of any job-specific specification are to be submitted with the initial set of engineering plans, for examination by Council. A total of three sets of the final specification are to be left with Council. One copy of the approved specification will be returned to the applicant.

1.3.4 Approval of Engineering Drawings and Specifications

Approval of Drawings and Specification will be made by the Group Manager of Operations, Lithgow City Council.

The correct fee must be paid at the time of plan lodgement, and three sets of engineering plans and calculations submitted to Council for examination. Upon approval of the preliminary plans, the developer shall make all necessary amendments and submit a final set of engineering plans. At this time the Construction Certificate will be issued, subject to compliance with consent conditions.

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

Further, the approval of engineering plans and specifications is current for a period of twelve months only. Should these guidelines change before the works are substantially commenced, the developer shall comply with the most recent version. If work has not substantially commenced inside of this twelve month period, the Group Manager of Operations may require revised Engineering Plans and Specifications to be submitted for approval.

1.3.5 Submission of Works Contractor Details

The applicant should provide written notice of the name, address and telephone number of the works contractor to the Group Manager of Operations at least seven days prior to the proposed date of commencement of any construction.

1.4 INSPECTION OF WORKS

All road, drainage, water, and sewerage construction works shall be inspected by Council's appointed officer during construction.

The type and frequency of inspections are detailed in Section 1.6.

The Applicant shall at all times give uninterrupted access and afford every facility for the examination of any works and materials requested by the Group Manager of Operations.

1.5 FEES AND CONTRIBUTIONS

Engineering drawings will be released upon payment of the appropriate plan checking and site inspection fees, current as at time of plan lodgement. Subdivisions and developments may also incur charges levied under Section 94 of the Environmental Planning and Assessment Act, Section 25 of the Water Supply Authorities Act, or as otherwise detailed in the development consent. The current value of these fees will be supplied upon request.

1.6 INSPECTION AND TESTING

All road, drainage, kerb and gutter, water and sewerage reticulation works associated with a development will be inspected by Council's Operations Department.

The procedure for testing road pavements, water reticulation and sewer reticulation is shown in Section 8.0 of these guidelines.

The developer shall at all times give uninterrupted access and afford every facility for the examination for any works and materials requested by the Group Manager of Operations or his authorised delegate.

The whole of the works are to be carried out to the satisfaction of the Group Manager of Operations.

Notwithstanding any inspection by Private Certifiers, Council will inspect engineering works at the following stages:

- Following site regrading and shaping, and prior to installation of footway services;
- Installation of erosion and sedimentation control measures;
- Storm water drainage lines prior to backfill;
- Water and sewer lines prior to backfill;
- Testing of water and sewer lines;
- Subgrade preparation, before placing pavement;
- Establishment of line and level for kerb and gutter placement;
- Completion of each pavement layer ready for testing;
- Road pavement surfacing;
- Completion of works

The developer or contractor should give Council a minimum 24 hours notice when requesting an inspection to ensure that development works are not delayed.

The developer shall, if required by Council's Development Engineer, submit delivery dockets for all materials used, and all material and performance test results obtained in the development.

If for any reason Council's supervising engineer should relieve the developer of the obligation to carry out construction works under the direct supervision of Council's staff, then the developer should, at the conclusion of the work, supply Council with a Compliance Certificate stating that the whole of the works have been carried out in accordance with the approved plans and specifications.

1.7 PUBLIC SAFETY

The developer shall not obstruct and will be held responsible for the safety of the public, traffic and utility services such as electricity, water, telecommunications and the like, and shall provide all watchmen, lights, barriers, signs and fences to prevent accidents to public or private damage or loss.

The applicant shall provide, erect and maintain all necessary temporary roads, bridges, footways, drains, supports and protection in order to ensure the above. These traffic control facilities shall be carried out in accordance with Australian Standards 1742.

1.8 DAMAGE TO PROPERTY

In the event of any utility service being damaged or interrupted the developer should forthwith notify the responsible authority and take all necessary steps to provide for the safety of the public and to have the damage repaired as quickly as possible. The cost of all repairs is to be resolved between the applicant and the relevant Authority.

Where private property is damaged, the applicant shall arrange with the concerned party replacement, repair, or otherwise. This cost is to be resolved between the applicant and the relevant party.

1.9 COMPLETION OF WORKS

When the developer is of the opinion that all works have been satisfactorily completed, the developer should make arrangements with Council's Development Engineer for a Final Inspection to be performed.

The applicant, superintendent, or contractor shall be present for the Final Inspection and shall assist Council's Development Engineer in checking of levels, opening of manholes etc. as required.

All street name signs, advisory / warning signs, and traffic control devices should be installed prior to Council's Final Inspection.

If all engineering works are satisfactory, Council will issue a Notification of Completion. Council's Development Engineer may allow minor errors, omissions, or defects to be bonded or completed during the maintenance period; however, any major defects or omissions must be repaired before a Notification of Completion will be issued.

1.10 WORKS AS EXECUTED PLANS

Following the satisfactory completion of engineering works for a development or subdivision, 'Works-As-Executed' (W.A.E.) plans prepared by a registered surveyor or professional engineer shall be submitted to Council's Group Manager of Operations. Such plan must be lodged prior to the release of the subdivision linen plan, or prior to occupation or use of the development.

The W.A.E. plans shall be Engineering Drawings as modified, and shall include the following items:

- invert levels of all drainage and sewerage lines at entrance and exit;
- location, class, size, and material of all pipes and subsoil lines;
- location and diameter of service conduits;
- pavement thickness as constructed;
- road centreline and kerb levels at all TPs, crests, sags, end of construction, and at 50 metre intervals on straights;
- footway widths at all TPs, centre of curves, and at each end of construction;
- location of kerb laybacks and vehicular driveways;
- location of stop valves, hydrants, water services, sewer manholes, sewer junctions, storm water and interallotment drainage pits;
- site regarding details – finished surface levels at centre of front and rear boundaries;
- contour depth of fill plans with depths in 0.25m increments shaded or hatched;
- the location and level of any permanent survey marks;
- any departure from approved plans, and additional work undertaken;
- show areas of lots which are unsewerable (ie, area where 1.667% fall from 0.6m below ground level to the sewer junction is not possible)

Each Works-As-Executed plan must include the following certification by the Registered Surveyor responsible for the preparation of the plan:

I certify that:

1. *This survey is a true record of the works that have been constructed, and*
2. *All drainage pipes and pits are located within the drainage easements and / or reserves shown on the linen plan.*
3. *All sewerage pipes and manholes are located within the sewerage easements and / or reserves shown on the linen plan.*
4. *All water pipes and fittings are located within the water easements and / or reserves shown on the linen plan.*

Signature: ..... Date: .....
Name: .....

Address: .....

1.11 BONDS AND GUARANTEES FOR PERFORMANCE

Where Council holds a bond or bank guarantee and works have not bee satisfactorily completed within the agreed time frame, the Group Manager of Operations may either grant an extension of time, or complete the works at the developer's expense. If serious defects arise which require urgent attention due to safety concerns or otherwise, Council may rectify works and shall either use the bond money as payment or bill the Applicant.

1.11.1 Maintenance Bond

Where a developer constructs or provides public infrastructure, a maintenance bond equal to 5% of the total development cost shall be lodged with Council prior to acceptance of the facility. A minimum bond amount of $1500 shall apply.

The maintenance bond is held by Council to ensure that all public infrastructure works have been constructed to a satisfactory standard, and can withstand the rigours of service conditions. Unexpended bond monies are refunded to the developer at the expiry of the maintenance period.

1.11.2 Maintenance Defect Period

The duration of the maintenance period shall be a **minimum** of 12 months from the date of lodgement of the bond, or from the date of a satisfactory Final Inspection of the works, whichever is the later. However, if in the opinion of the Group Manager of Operations, the infrastructure has not been subjected to normal operating conditions during this time, the maintenance period may be extended until such time as the facility has been adequately tested.

Within the maintenance period, the developer is expected to rectify any defect or omission which becomes apparent in the Development. Council may seize bond money to rectify faults if they have not been repaired within a reasonable time, or if necessary to urgently repair a defect which could conceivably cause harm or injury to persons or property.

1.11.3 Bond for Early Release of Linen Plan

Where engineering works for a subdivision or development are nearly complete, the Group Manager of Operations may accept a bond from the applicant for completion of works within a specified time after release of the linen plan. A non-refundable fee applies for preparation of the early release by the Group Manager of Operations, and the amount of the bond or bank guarantee shall be double the estimated cost of the works.

Early Release shall not be permitted in cases where the construction of water, sewer and stormwater infrastructure is not complete, nor if individual blocks are not accessible by an all weather road.

1.12 SURVEY REQUIREMENTS

All surveys shall be undertaken on Australian Height Datum.

All plans of survey are to show connection to at least two survey control permanent marks where practicable. Where it is intended to open a new road, at least two control marks per sheet of the subdivision plan are to be established in the road by the Surveyor, and connected to the nearest allotment corner.

The location and level of all permanent survey marks established as part of the works are to be clearly shown on the Works-As-Executed plans.

Survey Control Marks and lot boundaries shall be placed in accordance with the Surveyors (Practice) Regulation 2001, prior to the Final Inspection of the works.

1.13 MISCELLANEOUS

1.13.1 Adjoining Owners Consent

Where an applicant proposes to carry out work on an adjoining property, the applicant must submit the property owners written consent to Council before approval of engineering drawings will be issued.

At the completion of engineering works, a written clearance is to be obtained from the adjoining property owner and submitted with Council prior to the Final Inspection.

1.13.2 Lot Filling / Grading

Any areas to be filled or regraded are to be clearly identified on the engineering drawings. Provision shall be made to ensure that no ponding of water occurs on adjoining properties as a result of filling or regarding.

Where fill is to extend onto adjoining properties, or require a retaining wall at the property boundary, the adjoining owners consent is required.

The minimum lot grading shall be 1% towards a public road or interallotment drainage line, and a minimum 100mm of topsoil placed over all fill areas.

All filled areas should be compacted to a level commensurate with the proposed land use. Residential, commercial and industrial areas should be compacted to a minimum 95% Standard, with certification from a NATA registered laboratory.

1.13.3 Compliance with Acts

It is the responsibility of the applicant and contractor/s to ensure that all works are undertaken in a safe manner. In particular, the applicant and all contractor/s shall ensure compliance with the Occupational Health and Safety Act and any other relevant Acts, Ordinances, and Regulations.

1.13.4 Public Utility Services

Existing Road: Utility services to be installed across an existing roadway are to be underbored at a depth required by each individual utility service provider, as per the respective Specifications.

At no time whatsoever is an open trench to be cut, unless approved by Lithgow City Council.

Existing Footpath with Concrete Paving: The utility service provider is to install the service on its correct alignment and depth. If the alignment is within a concrete footpath, a minimum of 900mm in width is to be cut with a concrete saw prior to excavation. These saw cuts are to be in the same alignment as existing dummy joints or construction joints. The trench is to be backfilled with a granular material to the underside of the concrete footpath to a maximum dry density of 98% standard. Concrete Footpath restoration is to consist of N12 dowels, 300 long, placed into each side of the concrete at 450mm centres. The concrete is to be 20Mpa, and comply with the Australian Standard Mix Design.

Traffic Control: Both vehicular and pedestrian traffic is to be guided by signage conforming to AS1742.3. A Certified Traffic Planner must complete a Site Traffic Control Plan, and a copy of the Plan is to be kept on site during the works.

Services should be located in accordance with Council's Standard Drawing EN 1015.

All services should generally run parallel to the road centreline and cross the road perpendicular to the centreline unless otherwise approved by Council's Development Engineer.

All service authorities are to have completed the installation of services prior to the final inspection of the works by Council.

Should the installation of utility services require the opening of any public roads, reserves etc., then a road opening permit is to be obtained from Council. Restoration of disturbed areas must be completed to the satisfaction of Council's Development Engineer prior to the final inspection and release of linen plan.

1.13.5 Electricity, Natural Gas, and Telecommunications

The applicant is required to supply electrical, natural gas and telecommunications infrastructure, enabling all blocks to be serviced. The

infrastructure shall be installed in the service corridor as shown in Drawing EN 1015.

All infrastructure shall be installed in accordance with the requirements of the relevant Authorities.

1.13.6 Street Lighting

Where required under the Development Control Plan, the applicant is required to provide appropriate street lighting for the whole of the Development, with design in accordance with AS 1158.

The use of energy-saving lighting fixtures is encouraged; however no rebate will be issued to the developer if these type of lamps are approved.

Section 2.0 ROADS

2.1 INTRODUCTION

This section of the Guidelines for Engineering Works outlines Lithgow City Council's recommended practice for the design of roads. It is no way a comprehensive design manual, and is intended to complement the relevant Austroads and Roads and Traffic Authority publications.

2.2 ENGINEERING DRAWINGS

2.2.1 General

Engineering Drawing submissions are to include all information requested in Section 1.3.1 of these guidelines. The following section provides an outline of the road details which should accompany all design submissions.

2.2.2 Plan

Plans of all proposed roadworks shall be drawn at a scale of 1:500 and are to include the following -

I. lot boundaries and numbers
II. road centreline chainages, radii, tangent points and deflection angles
III. a benchmark within 100 m of the development site, with survey co-ordinates shown
IV. street names and north point
V. bar scales
VI. existing services, trees, structures, and other significant landmarks
VII. proposed service crossings
VIII. existing and new easements
IX. road reserve and carriageway width
X. all datum references to the Australian Height Datum
XI. symbol legend
XII. radii on kerb returns and kerb lines
XIII. vehicular crossings (both urban and rural)
XIV. existing and proposed contours
XV. proposed location of all street signs and pavement markings
XVI. location of soil test sites, and CBR values so determined
XVII. cycleways and footpaths
XVIII. cut and fill areas
XIX. building envelopes

2.2.3 Longitudinal Section

A longitudinal section of the centreline of the roads should be supplied at scales of 1:500 horizontal, and 1:100 vertical.
The longitudinal section of the road centreline shall include chainages, reduced levels at the existing and design surfaces, design grades, length of vertical curves, and location and type of services.
Longitudinal levels should be taken at 20 m intervals and at all intermediate changes of grade.
Longitudinal sections and cross-sections should be taken along existing intersecting roads for a sufficient distance (approximately 50 m) to enable kerb returns, dish crossings and any necessary drainage to be designed.

2.2.4 Cross-Sections

Cross-sections should be supplied at intervals not exceeding 50 m for straights and 20 m at curves, at scales of 1:100 natural. Cross-sections shall show chainage, reduced level of existing surface, design levels of pavement, kerb, gutter, and footpath.

Cross-sections should not be terminated at the property alignment but should be levelled sufficiently beyond the road boundaries, to enable batters of cutting and embankment to be shown.

A typical cross-section is to be included showing the following information -

I. crossfalls on carriageway and footway
II. type of kerb and gutter
III. depth, type of material to be used, compaction required for each layer
IV. of pavement
V. subgrade depth, compaction required and design CBR
VI. subsoil drainage
VII. concrete footpath, if required
VIII. type of surfacing

2.2.5 Kerb Returns

Kerb profiles should be shown for all kerb returns and cul-de-sac bulbs. A scale of 1:200 horizontally and 1:100 vertically is suggested.

2.2.6 Intersection Details

A contour plan shall be provided at all proposed intersections, roundabouts, and cul-de-sac bulbs. The contour interval should be selected to show variations in the design pavement surface levels, and so that the direction of surface runoff can be determined. A plan scale of 1:200 and contour interval of 0.1 metres is recommended.

2.2.7 Supporting Information

The following supporting information is to be submitted with the Engineering Drawings:

- A copy of the site investigation report, including test results
- Pavement design calculations
- A certification from the designer responsible for the pavement design.

2.2.8 Road Dedication

Where a survey is carried out for the purposes of a development and it is found that the constructed road falls outside the road reserve and into the development area, such land is to be dedicated as a public road as it is currently fenced, or if unfenced, a minimum of 5 metres from the edge of the road formation as constructed, for road purposes

2.3 DESIGN STANDARDS

This section is to act as a guide only, and Council reserves the right in specific circumstances to require more stringent standards depending on such matters as erodibility of soils, topography, drainage, expected traffic volumes and length of the road. All roads, carriageways and accesses are to be located and constructed in a manner as to provide maximum site distance whilst minimising cut and fill. Developers shall refer to Austroads "Guide to Road Design" and the RTA "Road Design Guide" for further guidance.

2.3.1 Road Hierarchy

In all areas, a road hierarchy must be established to ensure that a safe and efficient environment is provided for motorists and pedestrians. The road network shall be designed to passively discourage through traffic in residential areas, by creating a noticeable difference in speed environment and geometric characteristics relative to arterial routes.

Roads shall be designed for the maximum likely traffic volumes at the end of a 20 year design life, using the growth factors recommended in Section 7 – Design Traffic of the Austroads publication "Pavement Design".

Throughout the road system, roads should only connect with other roads of the same class, or up to two levels removed in the hierarchy.

2.3.1.1 Standard Road Widths

Urban				
Element	**Local Distributor**	**Collector**	**Local Access**	**Minor Cul-De-Sac**
No of allotments	>400	200-400	15-200	15
Road Reserve Width	20m	18m	15m	15m
Carriageway Width	13m	11m	8m	8m
Footway Width	2 x 3.5m	2 x 3.5m	2 x 3.5m	1 x 3.5m
Design Speed	60kph	60kph	40kph	30kph
Parking Provision	Carriageway	Carriageway	Carriageway	Carriageway
Kerb Type (depending on hydrological assessment requirements)	Rolled/Vertical	Rolled/Vertical	Rolled/Vertical	Rolled/Vertical
Rural				
Element	**Arterial**	**Collector**	**Local Access**	**Minor Roads**
No of allotments	> 100	50 - 100	10 - 50	< 10
Road Reserve Width	20	20	20	15
Carriageway Width	9.6	9.6	9.6	8
Minimum compacted gravel depth (mm)	Minimum 150mm - subject to testing			

Table 2.1 – Road Classification and Standards table

Table 2.1 provides guidance on the cross section characteristics which Council considers necessary to accommodate design traffic. The Group Manager of Operations will consider variations to the above standards where it can be demonstrated that such departure enhances the amenity of the locality and retains an appropriate road hierarchy.

Carriageway widths are measured at a location 150mm from the outside edge of the Kerb.

2.3.1.2 General Road Planning:

I. The necessary roads shall be carefully located and designed first taking into consideration the general topography of the area.
II. Allotments shall be planned around the roads, not roads planned to fit in with the allotments.
III. Where feasible, practicable and warranted, there should be distributor internal road(s) with 'branch', 'feeder' or 'minor' roads completing the internal road scheme.
IV. Generally, distributor road(s) will be required to extend to the limit of the proposed subdivision, particularly where additional adjoining subdivisions are considered feasible or access is in existence or considered desirable for any reason.
V. Bicycle-ways and pedestrian walkways shall be planned and designed for large subdivisions. The minimum width for such bicycle-ways and walkways shall be 3.5 metres.
VI. The minimum standard for the wearing surface of roads shall be a two coat bitumen seal.

2.3.2 Speed Environment

Speed Limits are determined by the Roads and Traffic Authority, and are typically 100km/h on highways and rural roads, 60km/h on local distributors, and 50km/h on residential streets. A speed limit of 40km/h applies within school zones for restricted periods.

Speed Environment is defined as the speed at which the 85th percentile driver will travel on the road network, and is largely controlled by design elements such as horizontal road geometry. Safe operating conditions are achieved by ensuring that sight distance is adequate for the speed environment thus created.

Table 2.1 above indicates the design speed environment of the road hierarchy in residential and rural residential areas.

2.3.3 Kerb & Gutter

An approved sealed pavement, including kerb and gutter, is to be provided to all classes of road having speed limits of 80km/h or less. It should be noted that Rural Residential roads are normally provided with a sealed shoulder, incorporating full depth pavement, in lieu of kerb and gutter.

Where it is considered impractical to construct an isolated section of kerb and gutter and road pavement, Council will require the developer to pay a contribution in lieu of construction, based on the estimated full cost of the works calculated by the Group Manager of Operations.

Note that sealed shoulders are only permitted where stormwater velocity on the road shoulder is kept below 2m/s in the 5% AEP event. In cases where this velocity is exceeded, the shoulder shall incorporate a concrete lined edge drain.

The following table outlines the requirement for the different classes of kerb and gutter shown on Council's standard drawing number EN 1006.

Road Edge Treatment	Used For:
1.0m wide sealed shoulder	• Rural Residential roads • Rural roads
150mm high intergral Kerb and Gutter	• Local distributor roads • Collector roads • Adjacent to public reserves
Roll Kerb and Gutter	• Local access roads
Semi-Mountable kerb	• Adjacent to medians, traffic islands and roundabouts

Table 2.2 - Road Edge Treatments

2.3.4 Cross Sections

2.3.4.1 Pavement Crossfall

The standard crossfall on bituminous pavements is 3% from a central crown. Cross-falls of up to 7% may be used for super-elevated curves or at road intersections. Super-elevation is not normally provided, but where design speeds so require, the super-elevation of horizontal curves is to be based on Austroads design policy for urban roads and the Roads and Traffic Authority "Road Design Guide" for rural areas.

In the cases where cross-fall from a central crown is not feasible, then on way cross-fall shall be permitted. One way cross-fall shall be nominally at grade of 3%, up to an absolute maximum of 6% in isolated cases. One-way crossfalls towards the gutter are required on any split-level carriageways.

Any proposal to vary these standards will require approval from the Group Manager of Operations

2.3.4.2 Offset Crown

Where local topography dictates that it is uneconomical to have the crown located on the centre of the road, the crown may be shifted towards the higher side of the road such that the maximum distance from the road centreline to the crown is 2m.

2.3.4.3 Footway Crossfalls

In areas where the footpath reservation is to be totally paved from the kerbline to the adjacent property boundary, the crossfall is to be 1 in 50 (2%) towards the kerb.

All other areas, whether unpaved or partially paved, shall be designed for a crossfall of 1 in 25 (4%) towards the kerb.

2.3.4.4 Batters

All roads shall be cleared to the width of the road reservation, or to a width sufficient to permit cut and fill batters, whichever is the greater.

Road batters should not be steeper than 1:3 (vertical:horizontal) in cuttings, and 1:3 in embankments, except with the approval of the Group Manager of Operations.

Any cutting or filling undertaken by the developer which is designed to retain a structure, or could possibly undermine or remove the support of any existing structure, will require the construction of a retaining wall. Plans and design calculations are to be submitted to the Group Manager of Operations for approval before the commencement of construction.

2.3.4.5 Split-Level Carriageways

Where sloping terrain necessitates split level construction, the width of the road reservation shall be increased to accommodate the standard width footways, as well as the approved carriageway and median widths.

Long lengths of split level road will not be permitted, nor may this type of construction be carried across street intersections without the written approval of Council.

Carriageways shall be widened to permit the maximum dimension emergency and service vehicles to have free and unimpeded access, in the event that vehicles are parked parallel to the kerbline. The width of the carriageway and median are to be determined in consultation with the Group Manager of Operations

The median may include a permanently retained batter not steeper than 1:4 (25%) to allow regular maintenance to be undertaken. Where minimum batter slopes can not be achieved, retaining walls shall be designed to accommodate the Austroads W7, T44 (Truck), and L44 (Lane) design traffic loadings.

Mountable type kerb and gutter is to be provided on the perimeter of the median island.

Section Six of the Roads and Traffic Authority “Road Design Guide” shall be referenced to determine whether safety barriers are warranted. Where necessary, the design and construction guidelines within this publication are to be followed.

2.3.4.6 Cul-de-Sacs

Cul-de-sacs are to be constructed so that a minimum kerbline radius of 9.5 metres is achieved from the centre of the cul-de-sac. The boundary of the road reserve should be curved with a minimum radius of 14 metres, to provide for a 4.5 metre wide footpath.

Where the head of the cul-de-sac is located on the low side of the road, special provision should be made to convey overland storm water flows through easements or drainage reserves.

Rural cul-de-sacs are to have a minimum radius (to edge of carriageway) of 12.5 metres, plus an additional 1 metre sealed shoulder. The boundary should be curved, to a minimum of 17 metre radius, to provide for a 4.5 metre footpath or verge.

Turning heads may be acceptable in lieu of cul-de-sac heads in some instances, where approved by the Group Manager of Operations.

2.3.4.7 Half-Road Construction

Where proposed subdivisions or development front one side of an existing sealed road, and the existing pavement is assessed as having adequate strength, and the vertical alignment complies with current standards, the existing pavement may be retained. The remainder of the half-width construction can then be carried out to the standard of the existing road. In all cases, the new seal should extend to the crown of the road to avoid irregularities.

Where existing pavement strength or road alignment is unsatisfactory, pavement construction shall extend to the road centreline.

2.3.5 Geometric Standards

The following guidelines have been developed to ensure that carriageways provide:

- smooth, safe and trafficable horizontal and vertical alignments;
- adequate sight distance;
- suitable vehicular and pedestrian access to building allotments;
- measures to prevent ponding of stormwater;
- a path for overland flow in major storm events.

2.3.5.1 Horizontal Alignment

Where an obstruction off the pavement, such as a street tree, restricts sight distance, the minimum radius of curvature shall be selected as the stopping sight distance for the adopted design speed.

However, it is preferred that the radius adopted should be determined using intermediate sight distance criteria as described in Section Two of the Roads and Traffic Authority “Road Design Guide”.

2.3.5.2 Longitudinal Centreline Grading

Local distributor roads, and those which are likely to be used as bus routes, are to have a maximum longitudinal centreline grading of 8%. All other roads should be designed with a maximum grade of 12%. However, grades of up to 16% may be permissible on straights for a maximum distance of 150 metres, depending on traffic volume and type. The gradient at street intersections where stop or give way signs are used should not exceed 3%.

A maximum grade of 10% shall be used adjacent to all street intersections, at locations of poor visibility, on horizontal curves of radius 15 metres or less, and at cul-de-sac. Cul-de-sac turning heads are limited to maximum grades of 5%.

Gutters are to have a minimum longitudinal grading of 1% for all roads, however consideration should be given to increasing this grade where changes of direction or drainage concentration occurs.

Proposals to vary the maximum and minimum permissible grades over short road lengths will be considered by the Group Manager of Operations, however such approvals will be strictly limited, and should be sought prior to incorporating these variations in the road design.

When designing roads on steep grades, considerable attention should be given to alternative road layouts, as the cost of constructing special storm water drainage structures on steep grades may be prohibitive.

2.3.5.3 Vertical Curves

Vertical curves are to be provided at all changes in grade. Where possible vertical curves should coincide with horizontal curves

The length of crest vertical curves shall be determined from the Roads and Traffic Authority “Road Design Guide”, based on stopping sight distance for the design speed environment, and an object height of 0.2 metres. Sag vertical curves should provide acceptable levels of comfort and allow adequate headlight sight distance.

2.3.5.4 Intersections and Roundabouts

Intersections involving only Non-Classified roads are to be designed in accordance with the standards shown in the Austroads “Guide to Traffic Engineering Practice, Part 5 - Intersections at Grade”. Intersections where at least one road is classified shall be designed in accordance with the Roads and Traffic Authority “Road Design Guide”.

In all cases, roundabouts shall be designed in accordance with the Roads and Traffic Authority publication, “Roundabouts - Geometric Design Method”.

2.3.5.5 Overtaking and Turning Lanes

Overtaking (or auxiliary) and turning lanes are to be provided where recommended by the roads and Traffic Authority publication “Road Design Guide.”

2.3.5.6 Kerb Returns

Kerb returns shall be designed for all roads to ensure a smooth trafficable surface around the return. The maximum longitudinal kerb grade and maximum pavement crossfall should not exceed permissible values.

Kerb returns shall be based on an 8 metre radius, however consideration should be given to increasing this radius where it is necessary to accommodate the turning circle of large vehicles and public transport.

As far as practical, low points within the kerb return should be avoided to prevent the use of pits with curved lintels.

2.3.5.6 Vehicular Access

Roads shall be located and designed so that vehicular access is readily available to all allotments using the standardised design vehicles detailed in Section 1.6.2 of the Roads and Traffic Authority “Roads Design Guide”.

At intersections, roads and building allotment layouts should be designed so that driveway access is not required directly opposite and within six metres either side of the prolongation of the side road property line on any terminating road, or within six metres of either kerb return tangent point.

A maximum of two vehicle crossings will be permitted to any allotment having sufficient street frontage, with the approval of the Group Manager of Operations.

2.3.5.7 Staged Road Construction

Where roads are constructed in stages of a subdivision, a permanent-type barricade shall be constructed at the end of that stage to warn motorists of the terminating road. These barricades, warning signs, and/or reflectors should comply with all requirements of Australian Standard 1742 - Manual of Uniform Traffic Control Devices, and only be removed upon commencement of the adjoining stage.

A temporary gravel turning area of minimum radius 9.5 metres is to be constructed at the end of the terminating roadway to permit the manoeuvring of service vehicles.

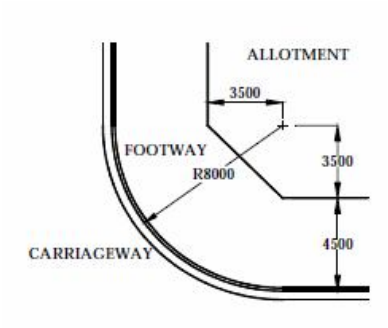
2.3.5.8 Road Reservation

Road boundaries may be curved, but where they are to be fenced as chords, these should be not less than 10 metres in length. Where a number of such chords occur adjacent to each other, they should be of equal length where practicable.

2.3.5.9 Corner Splays

Corner splays shall be incorporated on corner allotments to provide:

- sufficient space for utility service allocations to standard drawing EN 1015;
- a full width footway for pedestrian movement;
- sight distance for vehicles to Austroads standards.



These splays shall be determined so to provide for the above, however, should nominally measure 3.5 metres parallel to front and side boundaries of the corner allotment, and having a diagonal approximately 5.0 metres in length.

2.3.6 Laneways

Lanes are generally NOT permitted in new subdivision development. In special circumstances Lithgow City Council may consider a genuine need for construction of a lane.

In the case there is a submission for a lane creation; Lithgow City Council may consider such request subject to the following:

1. Existing adjoining amenity neighboring the new development. i.e. Existing access road, garage entrance
2. Is deemed to perform a necessary function for passage/access to existing local distributor roads ONLY.
3. Provides a passage of 'access' to facilitate the requirement of RFS trails.

As submissions are received, council will assess the request/need on a merit basis. Submissions will NOT be considered in the event alternate solutions are deemed possible.

Laneways approved by Lithgow City Council will be subject to Civil Engineering road, drainage and pavement design requirements to be negotiated with council's Group Manager Operations or his appointed engineer.

2.3.7 Footpaths and Cycleways

Where conditions of development consent require the construction of concrete footpaths and/or cycleways, these shall be designed and constructed in accordance with Council's standard drawing EN1009. Footpaths are generally 100mm thick and 1.2 metres wide, while cycleways

are 125mm thick and 2.0 - 2.5 metres wide. Perambulator ramps are required at all kerb crossings.

The maximum permissible footpath grade is generally 14%. Concrete steps will be required in accordance with Australian Standard 1428 where gradients exceed 14%. The maximum grade to be used in pathways providing access to public gardens and reserves shall be 8%.

Where footpaths are to be located within a pathway, they should be located centrally in the reserve. Drainage should be provided to ensure stormwater will not overflow onto adjoining properties. Refer to EN 1005 for detail.

The location of footpaths and cycleways is to be shown on the engineering drawings; however detailed designs will generally not be required.

2.3.8 Driveway Construction

2.3.8.1 Urban Access Driveways and Carparks

The requirements for the construction of Urban Driveways can be found in Council's Policy 10.21 – "Specification for the construction of Driveways, Footpath/Gutter crossings and Footpaving". A copy of the Policy is available at Council's Front Counter, or on the Council website.

Carparks and driveways from the kerb layback to the property boundary are to be constructed with the requirements below. The factors to be considered when designing vehicle access driveways maneuvering and parking areas include:

- Ensuring gradient is compatible with future footpath requirements (nominally, this will require a cross fall of no greater than 4% on the future footpath alignment);
- Existing natural surface levels at the property boundary;
- Where kerb and gutter does not exist, the design gutter invert level;
- Clearance requirements for the critical design vehicle;
- Preventing ingress of road water into the property;
- Ensuring driveway does not obstruct major flows within the roadway;
- Consideration of traffic loading,
- Location of existing utilities and services;
- Sight distances shall be as required by the RTA Road Design Guide.

Driveways and carparks should be constructed of full-width, 150mm thick, unreinforced concrete, having a characteristic strength of not less than 25MPa. Expansion joints should be provided using 9mm thick bitumen impregnated filler boards.

Alternatively, plain or coloured asphaltic concrete (hotmix) of 40mm thickness laid over 100mm compacted roadbase; 140mm thick asphaltic concrete; or paving bricks or blocks of minimum 65mm thickness laid in stretcher bond,

herringbone or basket weave pattern to manufacturer's recommendations may be used, with a 150x150mm concrete edge each side.

Other materials will be considered on request; however they should provide a durable, hard-standing crossing which is not subject to erosion, does not overly hinder access to footway services.

Commercial driveways will require consideration of axle loadings to determine the minimum required construction standard – see Section 2.3.7.3 "Commercial Driveways and Carparks".

All crossings are to be constructed to levels issued by Lithgow City Council's Operations Department. A compliance certificate should be obtained from Lithgow City Council or an accredited certifier, certifying that the driveway has been constructed in accordance with the design levels.

Where a driveway is dangerous, or may interfere with storm water runoff or pedestrian movements, and the driveway has not been constructed to levels issued by Lithgow City Council, Council have the power to direct the property owner to rectify the driveway.

Due consideration should be given to the position and floor level of building construction to ensure that vehicular access is possible.

Rural Access Driveways

Vehicular access locations shall be sited to take into account the following factors:

- Existing natural surface levels at the property boundary;
- Sight distances shall be as required by the RTA Road Design Guide
- Clearance requirements for the critical design vehicle;
- Preventing ingress of road water into the property;
- Ensuring driveway does not obstruct major flows within the roadway;
- Consideration of traffic loading,
- Location of existing utilities and services;

The property gate or stock grid shall be installed with a setback of 10m from the boundary of the land with the public road.

The access driveway shall have a minimum of 150mm of DGB-20 road base applied and compacted providing a smooth transitional surface. Access is to be constructed providing a minimum entry splay of 6.0 metres in width, tapering back into a minimum 4.0 metre wide internal access road. All access roads are to be (2) two-coat bitumen sealed from the edge of the road wearing surface to the entrance gate or stock grid. The bitumen seal shall conform to the RTA Sprayed Sealing Guide. Pavement design is to be in accordance with Section 2.4 "Pavement Design."

Based upon site conditions, either a 150mm thick, 6m wide dish drain, or a 450mm dia. (min) reinforced concrete pipe culvert with headwalls shall be constructed. See Drawing EN1011 for further details. Rural driveways intersecting an existing sealed road at grade will be required to be two coat

bitumen sealed internally for a minimum distance, to be determined on a case-by-case basis by the Group Manager Operations.

Rural driveways that will be used for significant commercial purposes will be required to have the gateway setback 20m from the boundary of the land. The minimum width of the driveway shall be determined by taking into consideration the maneuvering area required for a 19m semi trailer.

2.3.8.2 Commercial Driveways and Carparks

For commercial zoned lots, driveways and carparks shall be designed and constructed (noting the requirements of Section 2.3.8.1 "Urban Driveways and Carparks") to take into consideration axle loadings etc. Driveways shall be a minimum of 200mm of 25MPa concrete, with 2 layers of SL72 mesh, 50 top and bottom cover. Due consideration shall be given to the location of expansion and control joints.

2.3.8.3 Battleaxe Lots

Urban Battleaxe Lots are generally NOT permitted in new subdivision development. In special circumstances Lithgow City Council may consider a genuine need for construction of a battleaxe lot, in which case conditions for construction will be provided on a case-by-case basis.

For rural battleaxe blocks, the full length of the access handle (including footway crossing) shall be provided in accordance with section 2.3.9 Right of Carriageway.

2.3.9 Right of Carriageway (R.O.W.)

Right of Carriageways will generally only be considered by Council for developments in Rural Areas. Council considers three (3) allotments total to be the maximum number of allotments serviced by a right of carriageway for reasons of practical management, servicing, control and maintenance.

Definition: the primary allotment providing the R.O.W. and two (2) additional allotments benefiting.

Right of Carriageways are to be constructed to the following minimum standards:

Carriageway Width:	10 metres
Formation Width:	4 metres
Material:	A minimum of 150mm of DGB-20 road base applied and compacted providing a smooth, transitional surface.
Sealing:	All right of carriageways are to be two coat bitumen sealed where slope gradient exceeds 10%.
Drainage:	Drainage is to be provided along the full length of the carriageway formation. The type of drainage required will depend on topography of the area and will be determined by the Group Manager Operations.

2.4 PAVEMENT DESIGN

2.4.1 General

This section provides guidance on the design of flexible pavements consisting of two or more layers of unbound granular or cemented materials, where the primary distress mode is load related. The pavement designer shall also consider the effects of environmentally induced stresses from moisture and temperature which may affect pavement performance.

In general, residential pavements are to be designed in accordance with the requirements of the Austroads publication, “Pavement Design - A Guide to the Structural Design of Road Pavements”, by a qualified designer, as per

Section 1.3.2

Note that Section 8.2 (Testing) of this Guide shall be read in conjunction with this section.

2.4.2 Subgrade Evaluation

A site investigation is to be performed which is to include logging of test holes to a depth not less than one metre below design subgrade levels (unless rock is encountered). Soil tests shall be taken at the design depth and samples taken for CBR testing in accordance with Australian Standard 1289.

The design California Bearing Ratio (CBR) shall be selected following a careful assessment of the materials encountered in the site investigation, and the variability of subgrade moisture and density conditions likely in service. The design CBR value should assume poor drainage and shall be determined from soaked CBR.

A copy of the site investigation, including test results, is to be included with the Engineering Drawings.

Where the design subgrade CBR is below 3, the subgrade shall be chemically stabilised to a minimum depth of 150mm, and the pavement design based on a CBR of 3.

2.4.3 Pavement Materials

Pavements are to be constructed from a minimum of two layers using either unbound granular, cemented, or a combination of these materials. Layers are to be a maximum of 200mm thick after compaction.

Unbound granular materials are to consist of gravels or crushed rocks, and have a grading which makes them mechanically stable, workable, and able to be compacted. Small amounts of stabilising agents may be added to improve performance. Cemented materials are produced by the addition of cement, lime, or other hydraulically binding agent to granular materials, to improve the strength of the bound layer. Laboratory testing will be necessary to determine the proportion of cementitious materials to mix with the granular pavement materials.

The type, grading, and strength of materials specified for use within the proposed pavement are to be shown on the typical cross sections submitted with the Engineering Drawings.

2.4.4 Design Traffic

Pavements should be designed using the number of Equivalent Standard Axles (ESA's) shown in Table 2.1 of these guidelines.

Where circumstances dictate that a variation to these figures may be warranted, the developer should apply to Council for approval of the alternative. Such proposals are to be accompanied by careful estimates of the number of vehicles using the roadway by vehicle type, axle loading, and traffic growth over the life of the pavement. A minimum design life of 20 years shall apply for pavement design.

2.4.5 Drainage

Subsoil drainage pipes shall be installed on both sides of all new flexible road pavements, graded at a minimum longitudinal slope of 1% towards a suitable outlet, in accordance with Standard Drawings EN 1026 and EN 1027. Where this slope is not achievable, subsoil drainage shall not be used and guidance should be obtained from Lithgow City Council.

Subsoil pipes shall consist of a 100mm diameter slotted corrugated PVC pipe (or equivalent) enclosed in a geofabric sock, bedded in well graded filter material. Flushout points shall be installed at the upstream end of the pipe, and at regular intervals a maximum distance of 100 metres apart.

2.4.6 Design of Flexible Pavement

Pavement thickness design shall be based on the assessed subgrade strength, in accordance with guidelines contained in the Austroads publication, "Pavement Design".

Road shoulders are to be constructed using the full depth of pavement required for the adjacent traffic lanes. Note that the minimum depth shall be 250mm.

2.4.7 Pavement Surfacing

New urban residential, commercial, and industrial roads are to be surfaced with a minimum 40mm thickness of Asphaltic Concrete (AC) laid upon a sprayed bituminous prime coat, designed in accordance with the RTA publication "Sprayed Sealing Guide". Layers of asphaltic concrete may be included in the total design pavement depth, but should not be assigned a layer equivalency of greater than unity.

Where residential development fronts an existing sealed pavement in sound condition, a sprayed seal may be appropriate. Refer to Section 2.3.4.7 for further details.

Roundabouts are to be constructed using Grade 320, full-depth asphalt.

Rural and Rural Residential roads shall be surfaced with a two-coat sprayed seal over a prime seal which has adequate curing time.

Alternative surface treatments may be submitted to the Group Manager of Operations for approval, provided the surfacing exhibits the following characteristics:

- impermeable to air and moisture;
- a long service life, and is maintenance free for a considerable period;
- flexible;
- acceptably low longitudinal roughness;
- adequate low speed skid resistance;

2.4.8 Service Crossings

Where possible, all underground conduits, services and utilities shall be placed under the road prior to construction of the initial pavement course, and their location marked on the kerb and gutter. Trenches should be constructed at a minimum grade of 1% to permit drainage of sub-surface water.

Road crossings through existing pavements will require backfill using a 27:1 sand:cement mix to Standard Drawing EN 1022.

2.5 BRIDGES AND CULVERTS

Bridges and culverts shall be designed in accordance with Section 3 of these Guidelines.

2.6 ROAD FURNITURE

Road furniture shall be designed to minimise the number of roadside obstructions, and to ensure that the risk of injury to vehicle occupants and pedestrians is minimal.

2.6.1 Street Signs

Street signs are required at all road junctions. Signs may either be purchased from Council, or manufactured and installed in accordance with Council's standard drawing number EN 1010.

The location of street signs is to be shown on the Engineering Drawings.

2.6.2 Traffic Control Devices

Traffic signs, traffic signals, pavement markings, guide posts, delineators, safety barriers and the like, whether permanent or temporary, are to be designed and installed at all roads in accordance with guidelines contained within the Austroads publication, "Guide to Traffic Engineering Practice - Part 8: Traffic Control Devices", Australian Standard 1742 - Manual of Uniform Traffic Control Devices and the Roads and Traffic Authority "Road Design Guide".

The consent of Lithgow City Council's Group Manager of operations or appointed officer will be required prior to the installation of any traffic control devices on existing roads.

2.6.3 Local Area Traffic Management

Where conditions of a development consent so indicate, Local Area Traffic Management (LATM) devices are to be designed and installed to Austroads "Guide to Traffic Engineering Practice - Part 10: Local Area Traffic Management" and Australian Standard 1742.13 - Manual of Uniform Traffic Control Devices: Local Area Traffic Management.

2.6.4 Public Transport

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

When placing road furniture, consideration shall be given to the swept path of overhanging bodywork and the location of passenger waiting areas. Bus stops and shelters should always be located on the departure side of walkways and cyclepaths. The need to locally widen verges to provide visibility from adjacent driveways and intersections should be ascertained.

2.6.5 Road Lighting

Illumination shall be provided on all new roads and public thoroughfares in accordance with Australian Standard 1158 - Road Lighting. Notwithstanding these requirements, lighting shall be provided at all intersections, at the end of all cul-de-sac, and immediately in line with all pathways.

Lighting columns shall generally be located on the footway alignment shown in Council's standard drawing EN 1015.

Slip-base lighting columns are to be used where the light column will be located near the carriageway. Energy absorbing columns may be required where fallen columns would be particularly hazardous.

2.7 LANDSCAPING

Landscaping within the road reserve may be used for aesthetic reasons, or functional purposes such as screening headlight and sunlight glare, screening undesirable views, and providing visual guidance.

Plantings within the road reserve shall be designed so as not to obstruct sight distances. Particular care shall be taken with planting around curves, near intersections and driveways, and on pedestrian desire lines.

Only non-frangible trees, having a mature diameter of less than 100mm, shall be planted near road verges and medians.

Slopes steeper than 1:4 will not be mown, and consequently mulched groundcover or stone pitching should be specified if steep slopes are required in urban areas.

If landscaping works are to be carried out, then a landscaping plan showing, but not limited to, plant species and estimated height and spread of mature trees.

2.8 DESIGN REFERENCES

The following publications should be read in conjunction with the recommendations in these guidelines.

- AUSTRALIAN STANDARDS

1100	Supplement 4. Technical Drawing - Engineering Survey and Engineering Survey Design Drawing - Roads
1158	Road Lighting
1289	Methods of Testing Soil for Engineering Purposes
1348	Roads and Traffic Engineering - Glossary of Terms
1428	Design for Access and Mobility
1742	Manual of Uniform Traffic Control Devices

- AUSTROADS, *Guide to Traffic Engineering Practice*. (1988)

Part 1	Traffic Flow Characteristics and Theory
Part 2	Roadway Capacity
Part 3	Traffic Studies
Part 4	Traffic Accidents
Part 5	Intersections at Grade
Part 6	Roundabouts
Part 7	Traffic Signals
Part 8	Traffic Devices and Road Facilities
Part 9	Arterial Road Traffic Management
Part 10	Local Area Traffic Management
Part 11	Parking
Part 12	Roadway Lighting

- AUSTROADS, *Pavement Design - A Guide to the Structural Design of Road Pavements*, Sydney. (1997)
- MULHOLLAND, P.J., *A Structural Guide for Flexible Residential Street Pavements*, Australian Road Research Board. Special Report Number 41. (1989)
- ROADS AND TRAFFIC AUTHORITY, *Guide to Traffic Generating Developments*, Issue 2.0. (1993)
- ROADS AND TRAFFIC AUTHORITY, *Road Design Guide*. (1995)
- ROADS AND TRAFFIC AUTHORITY, *Sprayed Sealing Guide*. (1997)

Section 3.0 STORM WATER DRAINAGE

These guidelines outline Lithgow City Council's recommended practice for storm water drainage design. The broad objectives of these guidelines are to:

- Convey stormwater to receiving waters with minimal damage, danger & nuisance
- Stabilize landform and control erosion;
- Enhance the urban landscape, whilst maximizing land available for urbanization;
- Maintain the water quality of receiving waters.

Developers of land are to be wholly responsible for disposing of all stormwater run off which passes over or through the respective properties, roads and reserves.

The developer is required to maintain drainage works and to repair all defects which are, in the opinion of the Group Manager of Operations, due to faulty workmanship or materials, for a period of twelve (12) months from the date of Council approving the works. The developer is advised to ensure that all Contractors are bound by a similar maintenance clause.

For information regarding erosion and sedimentation control requirements refer to Landcom's Bluebook.

3.1 DEVELOPMENT IN SYDNEY'S DRINKING WATER CATCHMENTS

The Sydney Catchment Authority (SCA) manages and protects Sydney's drinking water catchments through the regulation of developments in the catchment areas, consistent with the Drinking Water Catchments State Environmental Planning Policy (the SEPP) or its equivalent. Land within Sydney's drinking water catchments must be developed in accordance with the requirements of the SEPP.

3.1.1 Objectives

(a) To ensure water catchments deliver high quality water while sustaining diverse and prosperous communities,
(b) To improve water quality in degraded areas where quality is not suitable for the relevant environmental values, and
(c) To maintain or improve water quality where it is currently suitable for the relevant environmental values.

3.1.2 Controls

Under the SEPP, Council cannot grant development consent unless it is satisfied the development will have a neutral or beneficial effect on water quality. In assessing whether a proposed development has a neutral or beneficial effect on water quality, Council must be satisfied that:

1. The development has no identifiable potential impact on water quality; or
2. Will contain any such impact on the site of the development and prevent it from reaching any watercourse, waterbody or drainage depression on the site, or
3. Will transfer any impact outside the site by treatment in a facility to the required standard and disposal approved by the consent authority, and
4. The development incorporates the SCA's current recommended practices (or equivalent standards and practices) which represent best industry or development practice in terms of maintaining water quality.

Any proposed development which Council believes does not have a neutral or beneficial effect on water quality must be referred by Council to the SCA, for a decision on concurrence, before development approval can be given. The SCA in granting concurrence may impose conditions to ensure a neutral and beneficial impact on water quality. If the SCA is not satisfied a neutral and beneficial impact on water quality can be achieved, concurrence will be withheld and Council will not be able to approve the development. For information on the SEPP and the SCA's current recommended practices, applicants should refer to the SCA's website at www.sca.nsw.gov.au

To enable Council and the SCA to assess whether a development will have a neutral or beneficial effect on water quality, all development applications in the drinking water catchments must be accompanied by a Water Cycle Management Study. The contents of a Water Cycle Management Study, including the information, reports and modeling required, will vary according to the type of development and the risks it poses to water quality, with more in depth studies required for developments that pose a higher risk. The SCA has published the Neutral or Beneficial Effect on Water Quality Assessment Guidelines to assist Council's applicants (available on the SCA's website at www.sca.nsw.gov.au) which categorises developments into five modules according to complexity and the risk to water quality.

3.2 ENGINEERING DRAWINGS

Engineering drawing submissions are to include all details requested in Section 1.3.1 of these guidelines. In general, storm water drainage designs should be presented in the format shown in Chapter 14 of Australian Rainfall and Runoff. Notwithstanding this, the following requirements shall apply:

3.2.1 Plans

Drainage plans shall be drawn at a scale sufficient to show all necessary details, nominally 1:200, 1:500, 1:1000 or 1:2000. The following data is to be included with a contoured catchment area plan:

(a) Catchment areas and sub-areas, watershed (catchment boundary), overland flow paths, existing and proposed pipe layout. For large catchments, the total catchment area should be shown at a large scale on a separate plan or inset.

(b) All sub-areas, drainage lines and pits are to be logically numbered.

(c) A schedule of pipe details, including pipe number, size, class, bedding type, joint type, invert levels at inlet and outlet, slope, and length.

(d) A schedule of pit details, including pit number, type, road chainage, surface level to the Australian Height Datum (AHD), invert level to AHD, depth, and lintel length.

(e) North point and legend.

(f) Setout information.

(g) Accurate position and level of all services and utilities which cross underground drainage pipelines.

(h) Identify those building allotments adjacent to channels and major storm flow paths which may be liable to flooding in major flood events, and the minimum design habitable floor level adjacent to prevent flooding in the design flood event.

(i) Inlet and outlet treatments.

(j) Measures for the prevention of erosion and sedimentation.

3.2.2 Longitudinal Sections

Longitudinal sections shall be drawn at a scale sufficient to show all necessary details, nominally 1:250 or 1:500 with a vertical exaggeration of 5, for all road drainage, interallotment drainage, and open channels. The following details shall be included:

(a) Road chainage (where applicable), cumulative pipe distance, design surface level, and design pipe invert level - all marked beneath the longitudinal pipe section. Longitudinal sections for channels and floodways shall be provided in a similar format to road longitudinal sections.

(b) Pit number, design pit inflow, pit type, pipe size, pipe class, trench installation, pipe velocity, and design pipe discharge.

(c) Hydraulic grade line.

3.2.3 Cross Sections

Cross sections shall be provided at all culverts, and for open channels at maximum 20 metre spacings.

Culvert details are to include all items required for longitudinal sections, and whether the inlet or outlet is the factor governing flow capacity.

Channel and floodway cross sections shall include details of hydraulic grade levels and available freeboard.

3.2.4 Supporting Information

All storm water drainage design submissions shall include drainage calculations and a certification from the designer. The designer must be a person, either holding qualifications acceptable for Corporate Membership of the Institution of Engineers, Australia, or approved by the Group Manager of Operations, and/or who has proven experience in the preparation of plans and specifications for land development.

3.2.4.1 Drainage Calculations

Hydrologic and hydraulic calculations shall be submitted with the design plans and based on a fully developed catchment. Details shall include:

(i) flow lengths, slopes and travel times, for overland and gutter flows.
(ii) full and partial area calculations.
(iii) the adopted return frequencies, runoff coefficients, and rainfall intensities.
(iv) pit inlet capacities.
(v) pipe lengths, full-pipe flow velocities, hydraulic grade line and pipe slopes.
(vi) pit pressure change coefficients.
(vii) pit and pipe invert and surface levels.
(viii) velocity times depth relationship for all overland flow paths.
(ix) design discharges.

3.2.4.2 Software Design Packages

Where commercially available software packages are used to design stormwater systems, a copy of all data files shall be provided to the Council prior to approval being granted. Note that the use of software does not negate the designer of his responsibility in ensuring an appropriate design which meets the requirement of this guide. The applicant will still need to submit detail as per Section 3.2.4.1 above.

3.2.4.3 Certification

The designer shall provide a statement to accompany the design plans, certifying that:

(i) all requirements contained within these guidelines have been met, and any proposed deviations from these guidelines have been documented in full.

(ii) Drainage reserves, parklands, and roadways are adequate to safely contain all flows from the design 1% Annual Exceedance Probability

flood event, and further, that the maximum velocity, maximum depth, and the product of velocity and depth, are all within prescribed limits.

(iii) That 500mm freeboard has been provided in the 1% AEP event with respect to building floor levels and all ground surface levels on each allotment within the development.

3.3 GENERAL REQUIREMENTS

Pipe capacities shall be calculated for pipes flowing full under gravity conditions.

The design flood frequency shall be the 1% Annual Exceedance Probability (AEP) event.

Storm water drainage systems in new areas of Lithgow shall be designed using a major/minor approach.

The minor drainage system consists of underground pipes designed to control nuisance flooding, while the major system consists of an overland flow path or floodway to accommodate less frequent flood events.

Where the drainage catchment includes an existing pipe system of unknown or limited capacity, the developer shall either:

- Replace or augment the existing pipe system;
- Modify the existing system, by acquiring land if necessary, to provide a safe major flow route;
- Hydraulically improve the existing system to reduce energy losses; or
- Limit the flows from new developments to keep downstream flows within the capacity of the system.

Major system drainage designs shall aim at controlling flood flows so that the severity of flooding downstream, and afflux upstream, is not increased. In all designs, consideration must be given to the effect of floods greater than the design flood, and in no circumstances should the design create conditions where the capacity of the downstream drainage system is exceeded.

The design flood shall be accommodated by the use of pipe drainage, drainage channels, overland flow paths, floodways, etc, as necessary, to accommodate the safe passage of floods in the event that the minor system is blocked.

Stormwater flows up to the design flood frequency shall be carried in a formal designed system of channels and/or pipes within the neighbourhood. No uncontrolled overland flow will be permitted for return periods less than the design flood.

Where stormwater discharge is concentrated onto other property, and/or works are necessary on the other property, it is the responsibility of the developer to make appropriate arrangements and provide Council with a copy

of the owners consent, prior to the release of a construction certificate for the works. This may necessitate the creation of an easement to drain water through downstream properties, and all costs and compensations are to be borne by the developer.

3.3.1 Annual Exceedance Probabilities

Annual Exceedance Probabilities for general use are shown in Table 3 below:

Land Use	Annual Exceedance Probability (AEP)
Road Drainage - Minor (Piped) System	
Arterial Roads (Cross Drainage)	2%
Rural & Rural Residential (Cross Drainage)	20%
Urban Residential	20%
Sag Point (must have a defined 1% AEP overflow route)	20%
Commercial	20%
Floodway 'low-flow' system	100%
Interallotment Drainage	20%
Trunk Drainage	1%

Table 3.1 - Annual Exceedance Probabilities

The major system drainage shall be designed to cater for flows from the 1% AEP storm event, with freeboard, on the assumption that the minor system is totally blocked. Continuous designated overland flow paths are to b provided from the top of the catchment through the entire urban area.

The designer shall consider special damage or danger to life and property which may occur in specific situations. In such cases, the design frequency of flooding recommended or adopted shall be the subject of specific advice and reports to Council for determination. In no circumstances shall the design flood be less than the 1% AEP flood event.

3.3.2 Design Rainfall Intensities for Lithgow

Design rainfall intensities for the Lithgow City Council Local Government Area shall be selected from the Table 3.2, based on the design storm duration and Average Recurrence Interval.

	RETURN PERIOD						
DURATION	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5 mins	60.7	79.3	105	121	142	170	192
6 mins	57	74.3	98.1	113	132	159	179
10 mins	46.4	60.4	79.3	90.8	106	127	143
20 mins	33.5	43.4	56.3	64.1	74.4	88.3	99.2
30 mins	27.2	35.1	45.1	51.2	59.2	70	78.5
1 hour	18.4	23.7	30.2	34.1	39.3	46.2	51.6
2 hours	12.2	15.7	19.9	22.4	25.8	30.2	33.7
3 hours	9.54	12.3	15.5	17.5	20.1	23.6	26.3
6 hours	6.25	8.04	10.2	11.5	13.2	15.5	17.3
12 hours	4.14	5.31	6.71	7.54	8.66	10.2	11.3
24 hours	2.77	3.54	4.42	4.93	5.63	6.56	7.27
48 hours	1.83	2.32	2.85	3.14	3.55	4.1	4.52
72 hours	1.4	1.77	2.14	2.35	2.65	3.05	3.35

Table 3.2 – Design Rainfall Intensities

3.3.3 Minimum Floor and Allotment Levels

All developable land, and all structures, shall be located a minimum 500mm above the maximum water level in the 1% AEP flood event.

For new subdivisions, the developer shall ensure that the lowest point in all allotments is located a minimum 500mm above the 1% AEP flood level.

Further, the developer shall note the minimum allowable floor level on the Work-As-Executed plans for all lots adjoining overland flow paths.

3.3.4 Fraction Impervious Figures

LAND USE	FRACTION IMPERVIOUS
Normal Residential Lot size < 1000m^2	0.6
Normal Residential Lot size > 1000m^2	0.4
Normal Residential Lot including half road	0.65
Half Width Road Reserve	0.85
Medium Density Residential Lot (villas, units)	0.85
Commercial Areas	1.00
Industrial Areas	0.90
Public Recreation Areas	0.5
Parkland, Public Reserve	0.1

3.4 ROAD DRAINAGE

The function of road drainage is to capture surface runoff from the design storm event, and safely convey it to an approved reserve or receiving waters with minimal damage, danger and nuisance to life, property and the environment.

3.4.1 Drainage Pits

3.4.1.1 General Requirements

(i) Pits shall be provided in drainage lines at all changes in grade, level, and direction, and at all pipe junctions and shall be spaced at no more than 85m apart.

(ii) Drainage pits are to conform to Council's standard Drawings, or RTA standards for Classified Roads. Non-standard structures shall be constructed as detailed in the design drawings. Such designs shall comply with AS3600 – Concrete Code, AS4100 – Steel Structures, AS1657 – SAA code for fixed platforms, walkways, stairways and ladders; and any other relevant standard.

(iii) Pits used for storm water drainage shall be fitted with square lids to distinguish them from sewer manholes.

(iv) Junction pits shall be fitted with reinforced lids and approved lifting eyes.

(v) Grated inlet pits shall not be used for street or roadway drainage.

(vi) Precast pits, incorporating insitu bases, may be used if the prior approval of the pit type and design are approved by the Group Manager of Operations.

(vii) Every endeavour shall be made to maintain flow velocities through pits. Excessive drops will not be permitted.

(vi) Pipe grading across pits should be designed on the following basis:

- No change in direction or diameter - minimum 50mm;
- Direction change but no change in diameter - minimum 70mm;
- Changes in pipe diameter should be graded from obvert to obvert;

(ix) At pit connections, a 3 metre length of approved subsoil drainage pipe enclosed in a geofabric sock shall be placed alongside the main pipe so as to enter the pit at the same invert level and adequately drain the main trench, in accordance with Council's standard drawing EN 1016.

3.4.1.2 Location of Kerb Inlet Pits

The following criteria governs the location of pits in roadways, for the adopted minor drainage system annual exceedance probability.

(i) Inlet pits shall be located so as to restrict the maximum gutter flow width to 2.5 metres.

(ii) Maximum spacing between any two consecutive pits is 85 metres.

(iii) Pit bypass flows should be limited to 15% of the gutter flow at that location.

(iv) At intersections, kerb inlet pits shall be constructed adjacent to the upstream kerb return tangent point where flows exceed 20 litres per second or gutter flow width is more than 1 metre.

(v) The minimum clearance from the top of the manhole to the design pit water level should be 150mm.

(vi) The product of flow velocity and depth of flow in the kerb and gutter should not exceed 0.4 m^2/s.

(vii) Kerb inlet pits should be located clear of horizontal curves, pedestrian desire lines, and vehicle driveways.

(viii) Inlet conditions shall be designed so that the potential for blockage by silt and debris is minimised. This may require special treatment of the inlet sump under some conditions.

3.4.1.3 Hydraulic Design

(i) Pit inlet capacities shall be estimated from design charts and formulae, based on lintel size for on-grade pits and depth of ponding for sag pits. The calculated inlet capacity shall be reduced by a factor of 50% for sag pits, and 20% for on-grade pits, on the assumption that debris is preventing some inflow.

(ii) Standard lintel sizes of 1.8, 2.4, 3.0, or 3.6 metres should be used when possible.

(iii) The minimum internal lintel size on a sag should be 2.4 metres.

(iv) The head loss through pits shall be determined from Missouri Charts or other recognised methods.

3.4.2 Drainage Pipes

3.4.2.1 General Requirements

(i) The inlet and outlet of all pipe systems shall be fitted with approved headwalls and energy dissipating devices to provide protection against scouring.

(ii) When constructing pipes under existing roads, pipelines should cross roads perpendicular to the centreline. For new roads, the length of pipes beneath roads should be minimised.

(iii) Pipe supports shall be Type H2 trench installation within footways, and Type HS2 trench installation under carriageways, as defined in Australian Standard 3725 - loads on buried concrete pipes.

3.4.2.2 Diameter

(i) Pipes in public road reservations shall have a minimum diameter of 375mm in urban areas and 450mm in rural areas.

(ii) For single cell pipeline systems of diameter less than 900mm, a downstream pipe of smaller diameter than the upstream pipe will not be permitted.

3.4.2.3 Material

(i) All drainage pipes used within public roads or paths shall be steel or fibre reinforced concrete (ie, RCP or FRCP, respectively) of spigot and socket type with flexible rubber ringed joints, and this shall be clearly indicated on the design plans.

(ii) Where curved pipelines are permitted, they are to be constructed using long-socketed rubber ring jointed pipes, installed strictly in accordance with the manufacturer's recommended radii, and must follow the service corridor as shown in standard drawing EN 1015

(iii) Pipe class shall be determined for a given pipe diameter, cover, trench installation and loading, using the tables in "Concrete Pipe Selection and Installation", published by the Concrete Pipe Association of Australia.

3.4.2.4 Gradient

(i) Pipes shall have a minimum grade of 1%, wherever physically possible, to permit self-cleansing under low flow conditions. Actual pipe velocity should be greater than 0.6m/s for self-cleansing, and less than 8m/s to prevent cavitation and scouring.

(ii) Concrete bulkheads shall be constructed for all drainage lines exceeding 16% grade, at intervals not exceeding 15 metres, in accordance with Council's standard drawing EN 1025.

3.4.2.5 Alignment

The normal alignment for storm water drainage pipelines of diameter up to and including 675mm shall be 0.6 metres behind the kerb line. However, this may be increased to 1.2m or 1.8m if required to clear power poles.

3.4.2.6 Cover

(i) Pipe cover of at least 600mm should be used wherever practical. An absolute minimum cover of 300mm shall be adopted.

(ii) The normal minimum vertical clearance between drainage pipelines and other services is 75mm.

3.4.3 Subsoil Drainage

Subsoil drainage pipes shall be installed at all new flexible road pavements, graded at a minimum longitudinal slope of 1% towards a suitable outlet, in accordance with Standard Drawing EN 1027. These pipes shall consist of a 100mm diameter corrugated PVC pipe (or equivalent) enclosed in a geofabric sock, bedded in well graded filter material. Flushout points shall be installed

at the upstream end of the pipe, and at regular intervals a maximum distance of 100 metres apart.

3.4.4 Easements

Drainage easements shall be created pursuant to Section 88B of the Conveyancing Act, 1919, where stormwater drainage pipelines pass through, or concentrate water onto, private property. When conveying surface runoff from road reservations, such easement should be in favour of Council. All other easements should be in favour of the allotments benefited only.

The width of these easements shall be sufficient to contain all storm water drainage infrastructure, and provide for future maintenance requirements. The minimum width of such easements are generally as follows:

Type of Drainage	Minimum Easement Width (metres)
Piped Drainage	
150 mm diameter	1.5
225 - 300 mm diameter	2.0
375 - 600 mm diameter	2.5
675 - 1050 mm diameter	3.0
1200 - 1500 mm diameter	3.5
1650 - 1800 mm diameter	4.0
Twin Pipes	(2 * Diameter) + 2.5
Floodway / Open Channel	Surface width of 1% AEP flow + 0.5m freeboard + 1.0m horizontally

Table 3.3 - Minimum Easement Widths

3.4.5 Special Provisions

3.4.5.1 Major Traffic Routes

Arterial routes shall be kept free of surface runoff in the 2% AEP flood event. Bridges and other major drainage structures shall be designed to pass the1% AEP flood with freeboard of 500mm. Afflux and hydraulic gradients shall be determined in all cases. Note that bridges shall be designed in accordance with the AUSTROADS publication *Bridge Design Code.*

Where surface flows cross a major road in the 1% AEP event, the maximum flow depth shall be limited to 150mm at the road centreline, and maximum flow length of 10 metres.

3.4.5.2 Cul-de-Sacs

Cul-de-sacs, where the fall is towards the turning head, shall have a floodway reservation or formed pathway in accordance with Council's Standard Drawing EN 1005, at the sag point to ensure that major flows can be

conveyed to a drainage reserve or overland flow path without flooding private properties.

3.4.5.3 Steep Grades

Close attention shall be given to the placement and location of drainage inlets to intercept surface water off steep grades. This particularly applies where a steep side street intersects a flat cross street. Mounding may be necessary opposite the intersection to protect properties from flooding, or a floodway reservation provided opposite the steep street. Concrete bulkheads will be required for all piped drainage systems in accordance with Section 3.4.2.4.

3.4.5.4 Energy Dissipation Structures

In certain circumstances, it will be necessary to provide energy dissipating devices on stormwater outlet structures, to minimise the effect of erosion.

Warrant for such structures will determined using the procedure as described in the Roads and Traffic Authority publication “Road Design Guide”.

3.4.5.5 Rural – Residential Subdivisions

Rural residential subdivisions shall have an appropriate combination of natural drainage courses and constructed contour banks and channels, to control the flow of stormwater through the subdivision, up to and including 1% AEP storm event, with 500mm freeboard.

3.5 TRUNK DRAINAGE

Trunk drainage systems are typically large capacity channels, that carry stormwater runoff from local street drainage systems to receiving waters. They typically serve large areas and overtopping is likely to cause nusciance and/or property flooding.

Trunk drainage generally comprises floodways and open channels to cater for 1% AEP flood events, with 500m freeboard. Floodways should be located along existing water courses or drainage depressions, unless exceptional circumstances exist and the prior approval of the Group Manager of Operations has been obtained.

3.5.1 Calculation of Flows

Flows through a trunk drainage network should be calculated using RAFTS or other appropriate runoff-routing computer model. The model shall be calibrated against a known discharge, or one calculated using a different method. Details of the method used to calibrate the model shall be submitted to Council with a hard copy of the model results.

Once calibrated, the model shall be used to analyse the impact of the development on existing flows, based on zero initial and continuing loss rates.

For design of new channels, a fully developed catchment shall be assumed.

3.5.2 Hydraulic Design

Open channels shall be designed using backwater calculations. A freeboard of 500mm above the 1% AEP flood level should be adopted.

The Group Manager of Operations will consider requests to vary the required freeboard, based on the risk of damage to life and property in large flood events.

Terracing may be introduced into the floodway where ancillary land uses, such as sports ovals, are also available for conveying the design 1% AEP flood event.

The product of velocity and depth should not exceed 1.0m_2/s in the 1% AEP event.

Centreline horizontal curves should have a radius not less than twice the 1% AEP surface flow width, with a minimum of 30 metres.

Recommended values for Manning's Roughness Coefficient are 0.013 for concrete lined inverts, 0.03 for gabions, 0.035 for maintained grass channels, and 0.02 for clear earth.

3.5.3 Low Flow Drainage

All open channels shall be provided with a low flow pipeline, or concrete lined invert of equivalent capacity, to cater for flows with an annual exceedance probability of 100%.

Low flow pipes shall have a minimum diameter of 450mm, and minimum longitudinal grade of 1%.

Road and interallotment drainage shall be connected to low-flow piped systems using a surcharge pit to Council's Standard Drawing EN 1018, sized to cater for the maximum discharge in the side line.

3.5.4 Flow Velocities

Piped low-flow systems shall have a minimum velocity of 0.6m/s for selfcleansing purposes.

Grass-lined channels shall be designed to ensure sub-critical flow with a Froude Number no greater than 0.8. Maximum velocity should be limited to 2m/s in the 5% AEP flood event, to prevent scouring. This velocity shall be reduced where necessary in highly erodable soils.

Where necessary, drop structures shall be provided, or flow lengths increased, to reduce velocities to acceptable levels.

3.5.5 Channel Stabilization

Permanent scour protection devices shall be designed for all discharge points into and out of the channel, and at all points where a significant change in flow conditions is likely.

Suitable species of grass should be planted in open channels.

Approved measures shall be taken to ensure that erosion does not occur at the interface between the concrete invert and the grassed floodway.

Open channels should be stabilised by turfing, hydromulching, or by installing a geotextile material having a minimum life expectancy of two years.

3.5.6 Batter Slopes

Batter slopes of grassed waterways should be a minimum of 1:6 (vertical:horizontal). Reductions to a minimum value of 1:4 may be used where approved by the Group Manager of Operations.

Minimum crossfalls in channels should be 2% with a depressed invert.

3.5.7 Road Crossings

In urban areas, the length of culverts shall be extended to the width of the road reservation, so that the standard width footways are provided on either side of the road. Headwalls, wingwalls, aprons, hand rails, guard rails, and safety barriers shall be provided in accordance with accepted practice, and relevant legislation and/or standards.

Trenches through existing roads where required shall be backfilled using a full depth, 27:1 sand:cement mixture as per standard drawing EN 1022. Where trenches are cut in areas where a new road is to be built, this treatment shall not be used.

Road crossings shall be constructed perpendicular to the road centreline.

3.6 OVERLAND FLOW PATHWAYS

Overland flow paths are required to convey runoff from major events to the trunk drainage system, without causing erosion, scouring or the like. All overland flow paths shall be designed to cater for the 1% AEP flood event without overtopping. These pathways should not be required to convey any runoff in minor events.

The design overland flow path may consist of public roads, pathways, catch drains, parks, open space areas and other public spaces only. Overland flow paths are not to be constructed over private property. For design purposes, the minor (piped) system shall be assumed to be fully blocked.

3.6.1 Public Roadways

The catchment area feeding roads that also act as overland flow paths shall be limited, to satisfy public safety and roadway flow capacity criterion. In general, a standard 11 metre wide road reserve should have a maximum catchment area of 20 to 30 hectares, and be designed for a peak flow of 2.5m^3/s. The product of velocity and depth should not exceed 0.4m^2/s.

Special care shall be exercised to ensure that continuity of flow is achieved, and that the floodway cross section is maintained at driveway entrances and the like.

Ready discharge shall be provided at the low point, and other relief points along the road, to quickly remove water and avoid ponding and deposition of gravel and silt.

Gutter flows on bus and arterial routes shall be limited to a maximum width of 2.0 metres, and depth of 125mm.

Overland flow paths should, where practicable, be provided within open space areas in preference to roadways.

3.6.2 Floodways in Open Space Areas

A suitably designed depression or flow path shall be provided for the entire length of the floodway. This particularly applies to smaller footpath reserves designed as floodways.

Special consideration shall be given to trapped low points where the overland flow path may divert surcharge into properties. This is especially important in the design of 'downhill' facing cul-de-sac, and kerb return adjacent to a sag vertical curve.

Where possible, tree and shrub plantings within floodway reserves should be located clear of the designed flowpath. If the use of shrubby plant material can not be avoided, the floodway width shall be increased to accommodate this factor.

Footpaving should be kept clear of the main flood flow, and be sufficiently thick and anchored to withstand the design discharge in areas of high velocity.

Grassed floodways shall be designed to avoid velocities in excess of 2 m/s in the 5% AEP flood event. Concrete inverts, or other approved erosion control measures shall be designed and constructed where flow velocities are excessive.

Where the ponding of water is likely at a road embankment, either:

(a) a larger return frequency shall be adopted when designing the underpass or culvert;

(b) property and floor levels shall be kept above roadway levels, or 500mm above the 1% AEP flood, whichever is the higher;

(c) the safety of the embankment for rarer floods must be considered, particularly if there is a hazard to urban development, or if a roadway or any other structure diverts flow away from the natural drainage path;

Where practical, open space, parkland reserves and retarding basins should be strategically designed on a whole-catchment basis and suitably located to improve downstream flow conditions and reduce flow velocities.

For major grassed channels and natural floodways (not small floodways in urban areas), signage shall be provided as shown in Figure 3.1 at all principal means of pedestrian access to the creek or floodway, advising people to take care at certain times. These signs shall include black lettering on white reflective plate, and have dimensions of 450mm x 600mm. The graphic is a 300mm triangle depicting a child in trouble within blue water.

Figure 3.1 (right) - Floodway Signage.

3.7 RETARDING BASINS

Where the downstream hydraulic capacity of one or more components in a drainage system is inadequate for the design flow, and/or where economically feasible, retarding basins are required at the discretion of the Group Manager of Operations.

3.7.1 Dual Use

Basins should provide for multiple land uses where possible. Active and passive open space areas may be viable alternative uses. However, landscaping and permanent structures shall be designed with due consideration of the basin's prime drainage function. Where possible, the floor of the basin shall be designed so to have a minimum slope of 1%.

Where recreational uses are proposed, the basin should be provided with low-flow drainage pipes or channels, each having minimum longitudinal grades of 1%. Advisory signs should be erected, warning of the intermittent safety hazard.

3.7.1 Design

While basins are generally designed and constructed to a specific brief, the following general guidelines shall apply.

3.7.1.1 Annual Exceedance Probability

The design shall be based on a critical storm event with an annual exceedance probability of 1%, however consideration shall be given to the

provision of non-catastrophic failure mechanisms and public safety up to the Probable Maximum Flood (PMF) event.

The design flood shall be passed entirely through a controlled system, and no uncontrolled outflow should occur. Defined spillways should be provided for flows in excess of the design flood.

Basin shall be sized depending on the degree of flow attenuation necessary to ensure that the downstream drainage system can pass the design storm event.

3.7.1.2 Embankments and Batters

Grassed batters and embankments should be no steeper than 1:3 (vertical:horizontal) for maintenance purposes, although steeper slopes may be accepted by the Group Manager of Operations in special circumstances.

All pipelines under embankments shall be rubber-ring jointed, and consideration should be given to the provision of suitable cut-off walls or seepage collars.

3.7.1.3 Water Levels and Freeboard

Where suitable land is available, basins should be designed for a maximum 1.2m depth of water in the 5% AEP flood event. Where constraints preclude this, the designer shall ensure that adequate safety precautions have been taken, such as the provision of raised refuge mounds, fences, and warning signs.

A freeboard of 500mm above the 1% AEP flood level shall be incorporated into the basin embankment, unless otherwise specified.

3.7.1.4 Erosion and Sediment Control

Inlet and outlet structures shall be designed to minimise scour. Peak flow velocities shall be limited to a maximum of 2m/s over grassed spillways and swales in the 5% AEP flood event.

3.7.2 Hydraulic Analysis

When calculating inflows, a fully developed catchment shall be assumed.

Basins shall be analysed using a suitable reservoir routing runoff model, such as RORB or RAFTS, using a recognised method. The model should be calibrated using either the Rational or Unit Hydrograph method.

The designer shall ensure that at no time will the basin outflow interact with the downstream system so as to produce peak flow rates above the capacity of the system.

Backwater profiles shall be checked to ensure that flood waters do not back up onto roads and properties in the 1% AEP event.

3.7.3 Spillways and Outlets

Spillways shall be designed to pass the 1% AEP and PMF events with minimal damage and no catastrophic failure.

Special attention shall be given to the surfacing of spillways using turf, concrete, stone pitching, gabions, or other approved low-maintenance, durable material.

Outlets shall be designed to minimise the risk of blockage. Clear access for machinery should be provided to permit removal of silt.

3.8 PROPERTY DRAINAGE

Property drainage systems are designed to convey surface runoff from roofs, paved areas, and other surfaces to a suitable outlet. Property drainage systems should be designed so that all runoff can drain naturally to the street gutter, interallotment drainage system, or road drainage system. Hydraulically 'charged' roof water systems, where the pipe outlet is at a higher elevation than some parts of the pipe invert, are not permissible within the Lithgow City Council area, as sediment and debris will tend to block the pipe.

Easements to drain water must be created where any component of the storm water drainage system is located within adjoining, privately-owned lands.

Two guiding principles which should be adhered to when designing drainage systems are:

(i) cause no detriment to downstream properties by either increasing, concentrating, or diverting flows;

(ii) cause no detriment to upstream properties by ponding or damming flows.

Australian Standard 3500 provides guidance for the design and construction of property drainage systems.

Note that stormwater shall be piped to the underground system whenever the discharge flowrate at the gutter is in excess of 30L/s per allotment, in a 5% AEP storm event.

3.8.1 Building Floor Levels

The floor level of new buildings should be carefully selected so that flood damage does not occur in major storm events. In particular, houses should not be cut into the natural surface, or located within a natural drainage depression, unless provision has been made for surface runoff to safely bypass the dwelling.

Those properties which are located on the low side of the public road, or adjacent to road sag points and drainage structures, should also take particular care when selecting the design floor level, in anticipation of a pit surcharge during major flow events.

Landscaping works such as terracing and the construction of retaining walls, should be designed to protect the dwelling, all site embellishments, and neighbouring properties, from inundation.

3.8.2 Building Adjacent to Overland Flow Paths

The floor level of properties located adjacent to overland flow pathways, trunk drainage channels, and natural streams shall be located a minimum 500mm above the top of bank level, or the surface of the 1% AEP design flood event, whichever is the greater.

3.8.3 Drainage Easements

Easements are generally created over all pipelines conveying road and interallotment drainage. Where road water is conveyed within an easement, generally no construction shall occur on or above the easement.

Construction works within stormwater easements may be considered by the Group Manager of Operations, provided that the below criteria are met:

(i) The stormwater pipe's condition shall be surveyed (using CCTV or similar) and evidence of this survey presented to Council. The survey shall extend 3m, or past the zone of influence (whichever the greater) beyond the structure. Where the pipe condition is not acceptable, or comprises flush jointed pipes, the developer will be required to replace the stormwater main with a size and material type as directed by Council.

(ii) The stormwater system shall be designed for a 1% AEP storm event, with the incorporation of a defined overland flow path to provide for stormwater system failures.

(iii) Structural loads shall be transmitted to the foundations outside of the zone of influence, as depicted in Figure 3.2 below. Concrete encasement of the pipe may be approved by the Group Manager of Operations in special circumstances, where some additional loads on the pipe are unavoidable. See EN 1032 for details.

(iv) Maintenance access shall be provided in accordance with Section 3.4.1.

(v) A Flood Impact Assessment shall be carried out, considering major event storms and system failure, to determine the effect upon the proposed construction works and neighbouring properties.

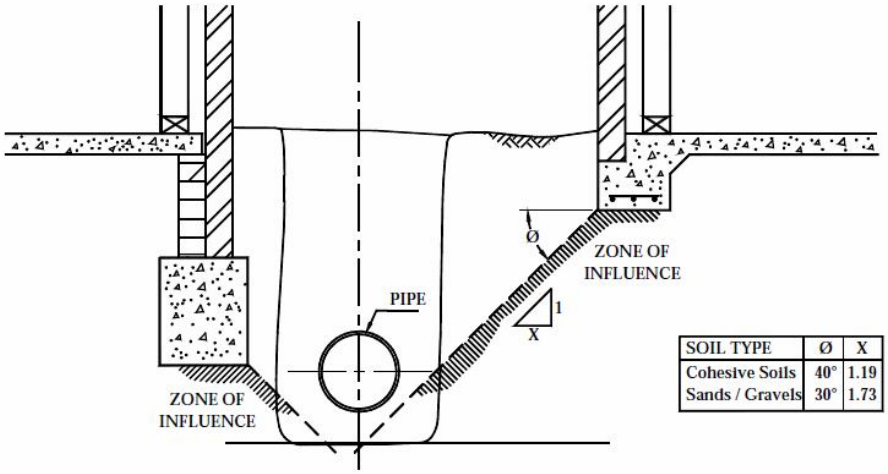


Figure 3.2 - Zones of Influence

3.8.4 Interallotment Drainage

Interallotment drainage systems are required whenever the lowest point in a building allotment can not be drained directly to the street gutter. These pipes are designed to drain both roof water and surface water to Council's underground drainage system.

3.8.4.1 General Requirements

(a) The interallotment drainage system shall be designed using the same principles as road drainage, based on a fully developed catchment area.

(b) Where existing allotments discharge runoff directly onto the development site, an interallotment drainage system (with appropriate easements) shall be provided to alleviate this runoff.

(c) Easements shall be provided over all interallotment drainage in accordance with Section 3.4.4 of these guidelines.

3.8.4.2 Pits

(a) Square grated surface inlet pits, of minimum size 600mm x 600mm, shall be provided at a suitable location on each affected allotment. The pit surface level shall be designed for the finished surface level of the property, taking into account likely cut and fill operations during building works.

(b) Pits greater than 1.2 metres in depth will require step irons in accordance with Section 3.4.1.1.

(c) Pits shall be provided at all changes in level, grade, and direction, and at all pipe junctions. Notwithstanding these requirements, the maximum pit spacing shall be 85 metres.

(d) All pits shall be provided with a 100mm diameter junction inlet, for the reception of underground roof water drainage pipes.

3.8.4.3 Pipes

(a) For minor developments and urban residential subdivisions of lot size not more than 800m2, the following guide may be used to determine the minimum permissible pipe diameter:

Number of lots	Minimum pipe size	Minimum pipe grade (%)
1 - 2	150 mm	2
3 - 5	225 mm	1

Table 3.3 - Minimum Pipe Diameter for 1-5 lots

Detailed designs and calculations are required for medium density developments, and subdivisions of more than five allotments.

(b) Pipes shall nominally be located a distance of one metre from side and rear property boundaries. Where sewer lines are laid parallel with interallotment drainage lines, the drainage line shall be located closer to the property boundary.

(c) Pipes shall be laid with a minimum cover of 300mm.

(d) Pipe material and class shall be selected upon consideration of installation and maintenance costs, pipe depth and the design loads. Materials which may be used without obtaining the separate approval of the Group Manager of Operations are rubber-ring jointed sewer grad unplasticised polyvinyl chloride (uPVC), fibre reinforced concrete, or reinforced concrete.

(e) Pipes shall be laid at a minimum longitudinal grade of 1%.

(f) In steep terrain, trench stops will be required in accordance with the requirements for sewer mains.

3.8.4.4 Pump-out systems

Pump out systems are not permitted for use within Lithgow City Council.

3.8.5 Absorption Trenches

Absorption trenches may be constructed in rural or rural-residential areas, where the property area and soil types are suitable, and no nuisance will be caused to neighbouring properties. Absorption trenches are not acceptable in new urban areas.

The sizing of “soakaways”, absorption, or seepage trenches is dependent on the hydraulic conductivity of the soils, and the consequences of any surcharging.

3.9 LANDSCAPING OF OPEN SPACE AREAS

The following general guidelines should be used for landscaping open space areas:

- No vegetation, other than grass, should be planted in channels and overflow paths beneath the surface level of the 5% Annual Exceedance Probability flood event;
- Grassed swales should have a minimum width of 2.5 metres;
- Batter slopes should have a maximum gradient of 1:6 (vertical:horizontal);
- Trees with clean boles, strong crown structure, and with no propensity to root suckering may be planted at minimum 3 metre spacings between the 5% and 1% AEP flood levels;
- No shrub or flow interference landscaping should be designed below the 1% AEP flood level;
- Open space areas should be grassed, and free of boulders, dirt and debris;
- All open space areas and drainage reserves should be trimmed to facilitate easy mowing.

3.10 DESIGN REFERENCES

The following publications should be read in conjunction with the recommendations in these guidelines.

AUSTRALIAN STANDARDS 3500 National Plumbing and Drainage Code

- DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT, *Urban Erosion and Sediment Control*, Revised Edition. Sydney. (1992)
- DEPARTMENT OF PLANNING, NSW, *Better Drainage - Guidelines for the Multiple Use of Drainage Systems*, Sydney. (1993)
- ENVIRONMENT PROTECTION AUTHORITY, NSW, *Managing Urban Stormwater - Treatment Techniques*, Sydney. (1997)
- ENVIRONMENT PROTECTION AUTHORITY, NSW, *DRAFT Managing Urban Stormwater - Construction Activities*, Sydney. (1996)
- INSTITUTION OF ENGINEERS, AUSTRALIA, *Australian Rainfall and Runoff - A Guide to Flood Estimation*, Third Edition, Canberra. (1987)

Section 4.0 ENVIRONMENT

4.1 INTRODUCTION

Land development can lead to significant environmental impacts, even on relatively small projects. These impacts include erosion, sedimentation, land degradation, habitat destruction, water pollution, air pollution, noise pollution and waste generation. With adequate planning and management, these impacts can be minimised or prevented altogether.

It is the requirement that the Development complies with the Clean Air Act, the Water Act and all other environmental Acts throughout the course of the development.

4.2 ENVIRONMENTAL IMPACTS FROM LAND DEVELOPMENT

4.2.1 Soil Erosion

Erosion is the wearing away of the land by the action of running water, rainfall, wind or ice. Human activities, including land development, often accelerates and intensifies this process. The factors influencing erosion include soil erodibility, rainfall intensity, surface slopes and vegetation cover.

According to information published by the Soil Conservation Service (now incorporated into the Department of Land and Water Conservation), the majority of the soils in the Lithgow City Council area have moderate to high erodibility.

The vast majority of erosion occurring on land development projects is due to the action of water.

4.2.2 Sedimentation

Sedimentation occurs when eroded soil is deposited at a new location either on land or in a water course. Once the runoff containing the eroded soil slows, heavier soil particles (coarse sands and gravels) will be deposited as sediment, then followed by smaller particles.

4.2.3 Land Degradation

Land degradation is the combined result of the soil erosion and sedimentation. The loss of the fertile topsoil layer causes sensitive plant species struggle to survive or re-establish. Under these conditions, infestations of noxious weeds can occur due to the weeds being more adapt to low fertility soils.

4.2.4 Destruction of Habitat

Remnant vegetation, especially native vegetation, may form part of a valuable habitat for native fauna or act as a "corridor" between such areas. These habitats may contain rare and endangered species of both flora and fauna.

Before commencing any construction work, consult with the appropriate authorities to ensure that there will be no negative impacts on any endangered flora and fauna. These authorities include, but are not limited to:

- New South Wales National Parks and Wildlife Service (NPWS)
- NSW Department of Environment, Climate Change and Water (DECCW) :Threatened Species Act
- Australian Government Department of the Environment, Water, Heritage and the Arts : Environment Protection and Biodiversity Conservation Act

4.2.5 Water Pollution

Not all eroded soil particles will go through the sedimentation process, with fine soil particles, nutrients and heavy metal contaminants. As a result, waterways become turbid (cloudy) and will have the effect of causing algal blooms and changing the biological composition of the waterway.

4.2.6 Air Pollution

The main forms of air pollution are:

- Dust
- Burning waste
- Vapours from volatile compounds

4.3 EROSION AND SEDIMENT CONTROL PLAN

This is the major component of the environmental management of a land development site. The Erosion and Sediment Control Plan (ESCP) is required to be submitted and approved by Council prior to any work taking place. The object of an ESCP is to minimise, preferably eliminate, the impacts of soil erosion and sedimentation resulting from land development activities.

The following is a guide as to what Lithgow City Council expects to be included in an ESCP. Please note that if the requirements as set out below do not met the satisfaction of Council, you will be asked to amend and resubmit the ESCP.

The ESCP is required to be presented as a suitably scaled drawing(s) (1:1000 or less) with the north point clearly marked and accompanied by detailed specifications and notes. The drawings, specifications and notes must be sufficiently clear so that they can be understood by on site staff.

See EN 1014 for an example of an ESCP

4.3.1 Site Characteristics

4.3.1.1 Topography

The contours, drainage lines and the catchment area are to be identified. The contour intervals as drawn on the ESCP should be in 0.5m intervals or less.

4.3.1.2 Soils

The ESCP should show the locations of the main soil types present on the site. In addition, the erodibility of the soil types should be presented. As a general guide, soils containing a large proportion of fine sands and silts or dispersive clays are usually moderately to highly erodible (specialist advice can be sought from the Department of Land and Water Conservation). Areas of rock outcrops should also be highlighted.

The areas of existing erosion and sedimentation problems (if any) should also be shown on the ESCP. These areas are more than likely to become a greater problem once land development starts and will require special attention.

4.3.1.3 Vegetation

The types of the existing vegetation and the areas that they occupy should be shown on the ESCP.

The different classes of vegetation should be identified as they vary in their capability to prevent erosion and filter sediments. A detailed flora survey using scientific names is not required to complete this component of the ESCP.

Where significant groupings of shrubs / trees are concerned, descriptions such as Acacia (Wattle), Eucalyptus (Gum), Melaleuca, Willow, Pine, etc are sufficient. Grasses can be described broadly as either native grasses or pasture grasses. Some indication should be given to the percentage ground cover the grasses provide.

Areas of weed infestation, especially noxious weeds, should also be noted on the ESCP.

4.3.1.4 Sensitive Areas

The areas within and adjacent to the development site, in particular, environmentally sensitive areas, should be highlighted in the ESCP. Sensitive areas may include rivers, floodways, creeks, wetlands, significant areas of native vegetation, national parks and heritage areas. Residential areas should also be considered as sensitive as significant erosion and sedimentation and affect the amenity of the area and possibly cause inundation from altered drainage patterns.

4.3.2 Extent of Proposed Works

4.3.2.1 Clearing of Vegetation

The area of vegetation proposed to be cleared must be shown clearly on the ESCP. Areas proposed for clearing must be kept to the minimum required to carry out the development. Excessive clearing of vegetation will not be considered as satisfactory.

4.3.2.2 Earthworks

All areas where topsoil is proposed to be stripped and proposed areas of cut and fill need to be shown on the ESCP. Excessive stripping / cut and fill works will not be considered satisfactory.

The ESCP should also include the plan / method proposed to be used to stabilise / repair any areas of erosion and prevent further sedimentation.

4.3.2.3 Materials Storage Areas & Stockpiles

All locations where stored materials and stockpiles are proposed to be positioned are to be shown on the ESCP.

Generally, stockpiles and material storage areas should be at least 2m, preferably 5m, from concentrated water flows and traffic areas and on slopes less than 1 (vertical) in 10 (horizontal).

4.3.2.4 Scheduling of Works

A schedule of the proposed works to be carried out is to accompany the ESCP. Obviously, the actual timing of the works will depend heavily upon the weather and other work commitments. The schedule is required to assess whether the works as proposed are staged correctly and that vulnerable areas are not left exposed for prolonged periods.

4.3.3 Proposed Erosion & Sediment Controls

The NSW Environment Protection Authority and the State Stormwater Coordinating Committee have produced a series of three draft documents titled “Managing Urban Stormwater”. Two of these documents, “Construction Activities” and “Treatment Techniques” are very useful in designing the erosion and sediment controls for a site. It is recommended that these documents be referred to in conjunction to the information presented below when preparing this part of the ESCP.

4.3.3.1 Diversion of “Clean” Runoff

The ESCP should show how it is proposed to minimize the amount of stormwater entering the site. Whilst the building site may be well vegetated and suitable erosion control measures in place, large volumes of stormwater runoff can still cause erosion and damage or destroy sediment controls. “Clean” water should be intercepted upgradient of the development site by an earth bank and diverted to a stable and undisturbed area.

4.3.3.2 Erosion Controls

There are likely to be situations where the existing vegetation and diversion of stormwater may not be adequate by themselves as erosion control. When this is the case, the ESCP should show the methods proposed to be used as further erosion control. This may include the use of soil binders, mulches, blankets and revegetation (see Section 4.3.3.5).

4.3.3.3 Interception & Treatment of "Dirty" Runoff

The ESCP should show the locations and details of the proposed sediment controls. These controls should have the aim to eliminate sediments entering sensitive areas and / or leaving the site.

The use of the existing vegetation will not be totally suitable as the only sediment control measure. Other sediment controls (eg. sediment filter (silt) fences, straw bale sediment filters, sediment retention basins, etc.) will be required. This applies to on site stormwater inlets as well as site boundaries. The use of sediment filter fences is preferred as these structures can perform better in situations of high flow and the materials can be reused from site to site if undamaged.

If, for some reason, it is felt that sediments may escape from the site in heavy rainfall events, due to site slopes, soil types, etc. then the Operations Department of Lithgow City Council is to be contacted to help arrange sediment controls for Council's stormwater system. This measure is to be used as a last resort only.

4.3.3.4 Access to Site

Access to the site, as shown on the ESCP, should be limited to one point only where possible. This all weather access will improve access to the site in wet conditions, reduce disturbance of the site and reduce the amount of mud that is deposited on the roadway that will be washed away by rain, possibly causing sedimentation problems and water pollution.

Where possible, the access should be 15m long by 3m wide. A berm (height 300mm) should comprise part of the all weather access adjacent to the site boundary (not the roadway). Compacted decomposed granite with a surface cover of 50-75mm gravel should be the used for the construction. The materials used in the construction of the all weather access can be reused once the building activity is completed.

Runoff from the access should be treated as "dirty" runoff and directed back into the site to the existing sediment controls.

4.3.3.5 Revegetation

A plan to revegetate the disturbed areas should be provided with the ESCP. This applies to both temporary revegetation (for disturbed areas, batters, stockpiles, etc.) and permanent revegetation (at the completion of the project)

The method of preparing the seedbed also required as part of this information. If in doubt, seek the advice of a professional landscaper,

gardener or refer to the Department of Housing documents *Guidelines for Grass Selection in NSW* (1993) and *Guidelines for Plant Selection* (1993).

4.3.4 Inspection and Maintenance

A program of inspection and maintenance is required to be provided with the ESCP**.** Suggested inspection intervals are:

- Once a week (on Friday), or;
- After a rain event, or,
- Prior to the site being unattended for a period in excess of 24 hours

All sediment and erosion controls should be repaired / cleaned if they are damaged / filled with sediment promptly.

4.3.5 Noise Pollution

Two goals are set by the NSW Environment Protection Authority in regards to noise. The first is that noise, as measured within one metre of a residence is less than 50 dB(A). A sound level of 50 dB(A) is approximately equivalent to normal conversation at a distance of one metre.

Some areas may have a "background" noise level in excess of 50 dB(A). In these circumstances, the NSW Environment Protection Authority recommends that the noise level not exceed the background level plus 5 dB(A). Any noise above this level is clearly audible over the "background" noise.

These two goals apply to daytime only. Daytime is defined as 7:00 am to 10:00 pm Monday to Saturday and 8:00 am to 10:00 pm on Sundays and Public Holidays.

4.3.6 Consultation

Both the Department of Land and Water Conservation and the NSW Environment Protection Authority may be consulted during preparation of an ESCP. These departments can provide specialist advice on soil types, erodibility, vegetation clearing, erosion controls, sediment controls, legislative requirements and management of sensitive areas.

4.4.3 Use of Chemicals

Many chemicals associated with land development activities can have short or long term effects on the environment and / or on people's health. Therefore, chemicals are always to be handled, used and disposed in accordance with the manufacturer's instructions.

When not in use, chemicals should be sealed to prevent the escape of vapours. Chemicals, if left on an unattended site, should be kept upright and sealed in an unexposed, secure area, preferably on an impermeable surface (such as concrete).

If a spillage or a leak occurs, the following action should be taken:

1. stop the spill or leak;
2. prevent the spill / leak from leaving the site and / or entering watercourses;
3. clean up the spill using a absorbent material (eg. sand or sawdust), and;
4. notify the NSW Environment Protection Authority and Lithgow City Council so that appropriate arrangements can be made to clean up and dispose of the absorbent material and any effected soil.

Please take note that on site disposal of chemicals is not, and never will be, an acceptable form of waste disposal.

4.4.4 Waste Management

The fees for disposal of waste at the Lithgow Waste Management Centre are more expensive for mixed waste rather than for sorted waste due to the increased cost of disposal and the lost opportunity of recycling. For current disposal fees, see the Lithgow City Council Schedule of Fees and Charges.

It therefore makes sense financially, as well as environmentally, to reduce, reuse and recycle wastes produced in the land development process.

Section 5.0 TRAFFIC MANAGEMENT

5.1 INTRODUCTION

This section covers work practices and protective measures for persons whose duties require them to work in the vicinity of traffic or mobile plant, and the safety of persons who may be affected by such work. Guidance is provided for the planning, design, installation and operation of traffic management schemes.

The organisation carrying out construction or maintenance operations on public lands must be aware of its responsibilities for any injury to road users or damage to property as a result of such operations, and should ensure that all works comply with the relevant Australian Standards and WorkCover requirements. There is a further obligation to provide a safe working environment which minimises the likelihood of injury by managing traffic within or adjacent to the work area. Steps should be taken to warn the public of prevailing conditions and to guard, delineate, and illuminate (if necessary) any work which may pose a hazard to traffic.

Four important basic principles to observe when performing road works are:

- Signs and devices shall be used in a standard manner and match the conditions at the work site.
- Signs and devices shall be erected and displayed before work commences at a work site.
- Signs and devices shall be regularly checked and maintained in a satisfactory condition.
- Signs and devices shall be removed from a work site as soon as practicable, however appropriate signs shall remain until all works have been completed (including loose stone removal and line marking).

5.2 SAFETY DEVICES

This section provides guidance on the type of safety devices necessary at construction sites. Details on the minimum number and placement of signs and devices may be found in the Roads and Traffic Authority publication ”Traffic Control at Worksites” Australian Standard 1742.3, and the various field guides for Traffic Control at Works on Roads.

Advance warning signs and devices shall allow adequate time for correct response under the worst anticipated conditions. All approaches to the work area, including any side roads, shall be provided for.

5.2.1 Condition of Traffic Management Devices

All traffic control devices used shall at all times be free from damage and operate as intended. Signs which are damaged, faded or dirty shall not be used and lighting devices shall operate as intended.

5.2.3 Delineation

The travelled path on the approaches and past the work area shall be delineated so that there is no doubt about which part of the roadway is available to traffic, or the path that traffic should follow, under all reasonably expected climatic conditions, day or night. Long range delineation using signs should provide advance warning to motorists, while short range delineation is usually achieved by line marking or pavement-based devices.

5.2.3 Night Conditions

Where devices are used during night conditions, the following shall apply:

- Signs shall be retroreflective or floodlit. Fluorescent signs are designed specifically for day time use, and must be illuminated if used at night. However, combination fluorescent/retroreflective materials may be suitable without floodlighting.
- Delineating devices shall be either lights or retroreflectors.
- Flashing lamps shall be used only to draw attention to signs, where necessary.
- Steady or ripple lamps may be used to define the limits of a nontrafficable area, and may replace a proportion of retroreflectors in a line of delineators.
- Pavement markings shall be retroreflective, using either raised retroreflective pavement markers, retroreflective preformed materials, or reflectorised paint with drop-on beads.

5.2.4 Adjustment to Existing Devices

Existing signs and traffic control devices which are inappropriate to, or conflict with, the temporary work situation shall be either covered, obliterated or removed. However, prior approval may be necessary from State or Local Authorities.

5.2.5 Temporary Safety Barriers

Temporary safety barriers shall be considered for long term works where any of the following situations are possible, or where a safe clearance between moving traffic and the hazard can not be achieved:

(a) Hazardous traffic conflicts (e.g. head-on collisions).

(b) Collisions with hazardous fixed objects, or falls into excavations close to the travelled way (especially road openings where no traffic controller is used).

(c) Safety of workers and/or plant is endangered.

5.2.6 Over-Dimensional Vehicle and Load Requirements

Where the width, height, or load-carrying capacity of the roadway or structure is to be temporarily reduced during works, the roads authority should be notified in advance so that arrangements may be made to divert traffic which would exceed temporary limitations. The authority should also be informed of the estimated finish time so that traffic can resume normal use of the roadway or structure.

Note that for State Highways the officer responsible is the Divisional Engineer of the Western Region, N.S.W. Roads and Traffic Authority, and for other roads, the Group Manager of Operations of Lithgow City Council.

5.3 CONSTRUCTION WORKS

5.3.1 Safety and Convenience

Work schedules should be arranged to use only the minimum practicable length and width of road, sufficient for worker safety and the work method employed, so as to minimise:

- disruption of established traffic movements and patterns;
- interference with traffic at peak movement periods and at night, weekends, holiday periods, or other special events.

The clearance between the edge of the work area and the edge of the adjacent traffic land should be at least 1.2 metres.

Signs and devices shall not direct a motorist to disobey a law unless an authorised person is present to direct traffic.

It is important that signs and devices for which the temporary or permanent need no longer exists, are covered or removed for the duration of the works.

5.3.2 Traffic Through the Work Area

The passage of traffic through a work area shall only be permitted where both the traffic and the work can be adequately controlled. One or more traffic controllers shall be employed as necessary to slow traffic, stop traffic for short periods, or to control single line flow. If necessary, controllers shall also be provided to control the movement of plant within the trafficable area.

5.3.3 Traffic past the Work Area

This will be the normal method of traffic management at sites where complete elimination of traffic is not required. Traffic paths past the work area shall be clearly delineated and pre-work delineation obliterated where feasible for long term works.

5.3.4 Side Tracks and Detours

Where necessary, traffic may be accommodated by a detour using existing roads, or a specially constructed side track.

5.3.5 Pedestrian and Bicycle Access

Where pedestrians and bicycles must move through or past a work site, they shall be provided with and directed to suitably constructed and protected temporary footpaths, crossing points, or refuges if warranted. The surface condition of any relocated paths or temporary facilities must be suitable for strollers and wheelchairs. Further, lighting should not be less than that provided on the original crossing.

5.3.6 Daily Routine Tasks and Record Keeping

A recommended daily routine for the operation of a work site, including the keeping of daily records for the sign arrangement or traffic guidance scheme, and records of any incidents which may have ongoing consequences, is given in Appendix A of Australian Standard 1742.3.

5.3.7 Illumination

Before darkness falls, the person controlling the work site must ensure that hazards or barriers are conspicuous, and that traffic warning lamps are in good working order, and clearly visible to oncoming traffic. Care should be taken to ensure that any lighting does not cause glare for approaching drivers.

5.3.8 Working with Mobile Plant

Vehicles and plant used in or around the work site should be clearly visible.

Persons should not be placed at risk when working near mobile plant. Special consideration should be given to soil technicians, surveyors, and the like within the workplace.

Where plant and equipment is capable of reversing and the operator may have obstructed vision, it may be necessary to fit an audible reversing alarm unit. However, reversing alarms may cause confusion where multiple plant is using the same area.

5.3.9 Personal Protective Equipment

Before commencing work, the contractor responsible for the work should assess any conditions likely to affect the health and safety of all personnel on the work site. All personnel on site shall wear high visibility garments.

During night, or in poor light conditions, garments should be fitted with retroreflective silver tape front and back, covering not less than 30% of the vest or garment area.

Wet weather clothing should be of fluorescent red, orange, or yellow material. At least two hoops of 50mm wide retroreflective material should be incorporated into the garment for use in dim conditions.

Eye protection complying with Australian Standard 1337 should be used where hazards dictate.

Persons exposed to sunlight in the course of their work should be protected from ultraviolet radiation using a sunscreen with a sun protection factor rating of at least 15+, and following the manufacturers directions.

Other protective equipment which shall be considered includes safety helmets, hearing protection, gloves, safety boots, and respirators.

All personal protective equipment should be regularly inspected and replaced as necessary.

5.4 TRAINING & INSTRUCTION

Traffic controllers are to be trained and certified to at least the equivalent of the RTA's traffic controllers course.

Persons designing traffic control plans shall be trained to the equivalent of the RTA's training course for providing work site traffic control layouts.

5.5 STATUTORY PROVISIONS

Occupational Health and Safety Act, 1983.

Occupational Health and Safety Act (Manual Handling) Regulation 1991.

Construction Safety Act and Regulations.

5.6 REFERENCES

The following publications should be read in conjunction with the recommendations in these guidelines.

- AUSTRALIAN STANDARDS

1742 (Set)	Manual of Uniform Traffic Control Devices
1742.2	Traffic Control Devices for General Use
1742.3	Traffic Control Devices for Works on Roads
1158	Road Lighting
1165	Traffic Hazard Warning Lamps
1348	Roads and Traffic Engineering - Glossary of Terms
1906	Retroreflective Material and Devices for Road Traffic Control Purposes
4191	Portable Traffic Signal Systems

- STANDARDS AUSTRALIA HANDBOOKS

SAA HB81	*Field Guide for Traffic Control at Works on Roads:*
Part 1	Short-Term Urban Works, Daytime Only
Part 2	Short-Term Rural Works, Daytime Only
Part 3	Mobile Works
Part 4	Short-Term Night Works
Part 5	Works on Unsealed Roads
Part 6	Bituminous Surfacing Works

- WORKCOVER NSW PUBLICATIONS

Codes of Practice:
- Working Near Traffic and Mobile Plant
- Electrical Practices for Construction Work
- Safety Line Systems
- Amenities
- Concrete Sawing

Skin Cancer and Outdoor Workers:
- A Guide for Workers
- A Guide for Employers

Providing First-Aid at Work
Hazpak

- ROADS AND TRAFFIC AUTHORITY PUBLICATIONS

Traffic Control at Work Sites
So You Want to be a Traffic Controller

APPENDICES

A TRAFFIC MANAGEMENT

B SYDNEY CATCHMENT AUTHORITY (SCA) AREA MAP

Appendix A - TRAFFIC MANAGEMENT

Daily Routine Tasks & Record Keeping

Record Keeping

Supervisory personnel engaged on works which require the use of a traffic guidance scheme should keep the following records:

(a) Daily records of the sign arrangement or traffic guidance scheme should be kept in a diary or in work sheets. Special attention should be given to recording the installation, alteration and removal of all regulatory signs and devices, including speed restriction signs. The records should include the hours of operation and the surface condition of the road. Any significant departures from, or additions to, the signs and devices depicted in the relevant Australian Standard figures should also be noted.

(b) In the case of accidents, either witnessed or reported, involving the public or from which legal proceedings may arise, the actual type, location and size of signs and devices in use at the time of the accident should be recorded and the sign arrangement photographed for subsequent reporting. Details of the actual width and condition of the travelled path and weather conditions should also be recorded.

Daily Routine Tasks

General

Supervisory personnel should establish a daily routine which allots specific tasks to personnel, including supervisors, so that:

- loss of production time is minimized;
- plant operations are not disrupted;
- signing at all times is adequate for the safety of personnel and traffic;
- the surface of the travelled path is maintained in a satisfactory condition.

The supervisor's role in this routine procedure is coordination, inspection and correction.

Before Work Starts

The following procedure should be undertaken before work starts each day:

- An inspection of all traffic signs and devices should be made. All signs out of place or damaged during the night should be noted for subsequent rectification.
- All lamps should be switched off and checked and cleaned, if necessary.

- After adjustments have been made to the traffic management provisions for the day they should be checked for safety and effectiveness by an inspection drive through the project, and a record made of the signs erected and their locations.

During Work Hours

The following routine should be followed while work is in progress:

- Periodically drive through the work site to check that all signs, markings and delineating devices as seen by other road users are satisfactory and in their correct position.
- Attend to minor problems as they occur.
- During work breaks (e.g. tea breaks):
    - move personnel clear of the work area;
    - park plant clear of traffic lanes;
    - remove from view or cover inappropriate signs such as PREPARE TO STOP or Workers Ahead, if workers leave the site or cannot be seen.
- Where there are traffic hazards or where only one lane is open to traffic, instruct traffic controllers to remain on the job and relieve them as necessary.
- Reposition barriers, signs and tapers as necessary. For example, adjust the length of single traffic operation as necessary to keep it to a minimum, and keep records of changes made and the time these occurred.
- Coordinate maintenance of the travelled path with other job operations.

Closing Down at the End of the Day

Special provisions are required if less than one lane in each direction is available after working hours, during weekends or holiday periods. Depending on the situation, this may include rostering traffic controllers to work for the full period of the obstruction, illumination of the work site, or the installation of portable or temporary traffic signals.

In general, the following action is required at the end of each days work:

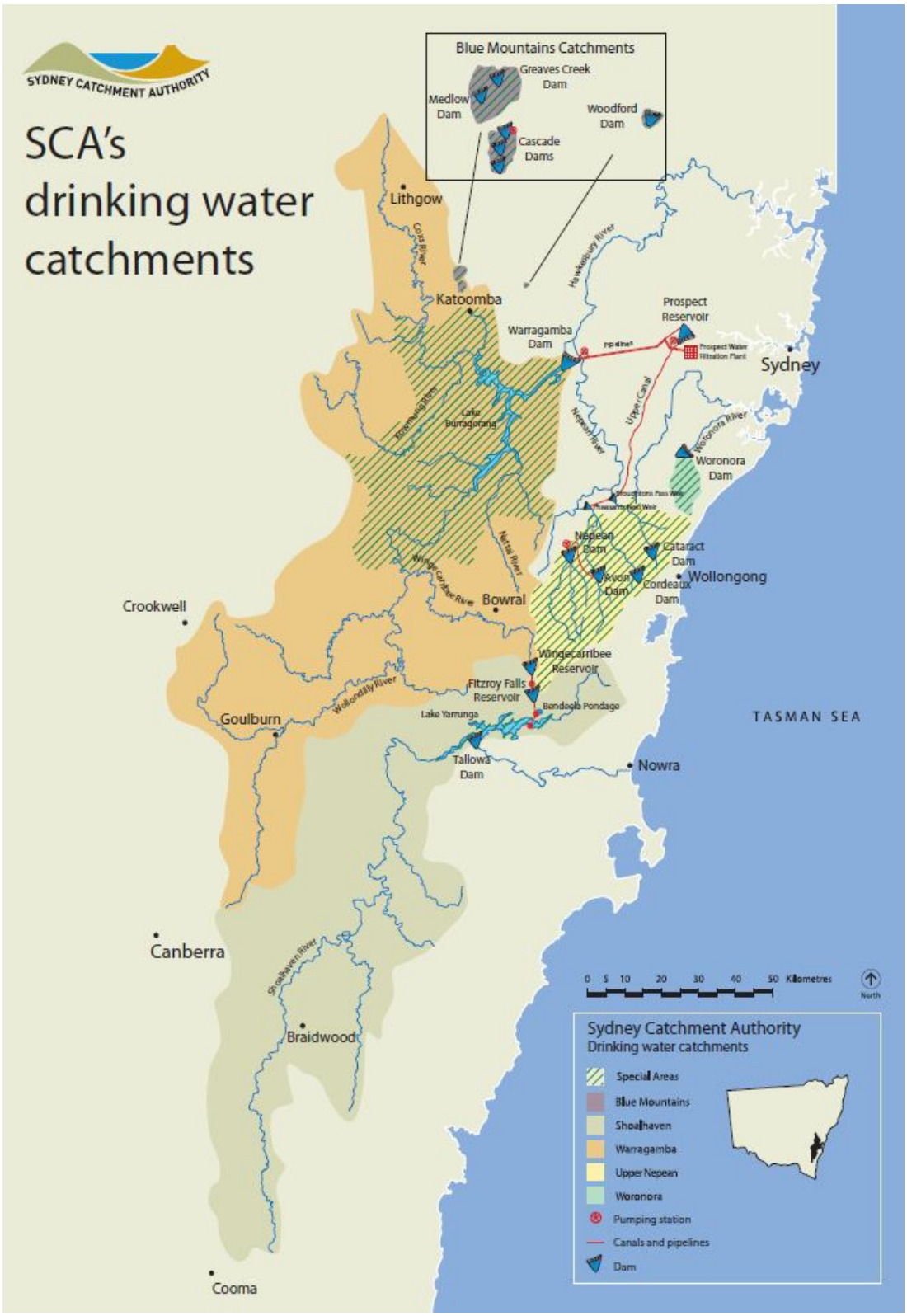
- Carry out a pre-closedown inspection allowing time for urgent maintenance to the travelled path.
- Remove PREPARE TO STOP, Workers Ahead, and other inappropriate signs.
- In cases where barriers are to remain, affix and light lamps.
- Drive through the work site to confirm that signs and devices are in position and operating before leaving the site.
- Finally, record any changes that have been made to the previously recorded sign arrangement or traffic guidance scheme.

After Hours

During the hours when work is suspended:

- Make arrangements for personnel to check lamps after dark and to maintain the lamp system during weekends and holidays;
- Provide after hours contact so that arrangements can be made to replace damaged signs, delineators or barriers.
- Ensure that a record is kept of signs found damaged, missing or out of place (and their location) at night, weekend or holiday inspections.
- Carry out periodic after-dark inspections on low headlight

Appendix B – SYDNEY CATCHMENT AUTHORITY AREA MAP



Standard Drawings

Item	Title	Drawing Number
1	Standard kerb and gutter details	EN 1006
2	Perambulator crossing	EN 1007
3	Street intersection median island	EN 1008
4	Concrete cycleway	EN 1009
5	Street signs	EN 1010
6	Rural road access	EN 1011
7	Urban road access	EN 1012
8	Trench shielding requirements	EN 1013
9	Erosion and sediment control requirements	EN 1014
10	Footpath allocations for public utility services	EN 1015
11	Kerb inlet pit	EN 1016
12	Junction pit and catch drains	EN 1017
13	Surface inlet / surcharge pit	EN 1018
14	Field inlet / interallotment pit	EN 1019
15	Penstock (floodgate) pit	EN 1020
16	Footpath surface inlet pit with grate	EN 1021
17	Storm water pipe bedding	EN 1022
18	Storm water kerb inlet pit deflector	EN 1023
19	Footpath converter for house storm water line	EN 1024
20	Straight concrete headwalls and concrete bulkheads	EN 1025
21	Sub-soil drainage lines	EN 1026
22	Sub-soil drain flush-out point and outlet structures	EN 1027
23	Manhole construction	EN 1028
24	Drop manhole construction	EN 1029
25	Sewer capped riser construction	EN 1030
26	Sewer reticulation pipe bedding	EN 1031
27	Sewer main concrete encasement	EN 1032
28	Water hydrant and valves	EN 1033
29	Water main reticulation bedding	EN 1034
30	Water main thrust blocks	EN 1035
31	Water services	EN 1036
32	Water main covers, indicator posts & markers	EN 1037
33	Water main layout for cul-de-sac	EN 1038
34	Standard Detail - Floodway within pathway alignments	EN 1005