



CAMDEN COUNCIL

ENGINEERING CONSTRUCTION

SPECIFICATION

Adopted 10 February, 2009

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GLOSSARY

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

AC refers to asphaltic concrete.

ACRS shall refer to the Australian Certification Authority for Steel Reinforcing.

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

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

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

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

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

AR&R refers to the current edition of Australian Rainfall and Runoff published by the Institution of Engineers Australia.

ARI refers to the Average Recurrence Interval, which means the average period (in years) between occurrences of floods, storms and flows of a particular magnitude.

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

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

BCA refers to current edition of the Building Code of Australia prepared by the Australian Building Codes Board

CBR refers to California Bearing Ratio.

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

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

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

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

Council's Engineer shall refer to either the Development Control Engineer or the Director of Engineering, or similar title, of Camden Council or a representative thereof unless otherwise stated.

CPTED refers to Crime Prevention Through Environmental Design.

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

DEC refers to the New South Wales Department of Environment and Conservation or its name change (i.e. New South Wales Environment Protection Authority).

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

DNR refers to the New South Wales Department Natural Resources or its name change (i.e. New South Wales Department of Land and Water Conservation or Department of Infrastructure, Planning and Natural Resources).

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

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

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

EPA refers to the Environmental Protection Authority.

ESCP refers to an Erosion and Sediment Control Plan.

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

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

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

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

NATA refers to the National Association of Accredited Testing Authorities.

NPER refers to the National Professional Engineers Register.

OH&S refers to requirements under the Occupational Health & Safety Act (2000), as amended.

OSD refers to On-site Stormwater Detention.

Owner shall refer to the property owner at the time.

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

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

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

PSD refers to maximum Permissible Site Discharge.

RCP refers to Reinforced Concrete Pipe.

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

Road Authority is either the RTA, Council or a specified Public Authority as defined under the Roads Act (1993).

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

RTA refers to the New South Wales Roads & Traffic Authority or its name change (New South Wales Department of Main Roads).

Section 149 Certificates or S149 Certificates refer to Clause 279 of the Environment Planning and Assessment Regulation 2000 which prescribes the matters to be specified in a planning certificate under Section 149(2) and (5) of the Environment Planning and Assessment Act (1979).

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

Site shall refer to the area of land being developed or the works undertaken.

Specification shall refer to this document.

Supervisor is a representative of the Contractor that is on-site at all times and liaise between the Contractors and Council.

Surveyor is a land surveyor and may be a Registered Surveyor, as may be required..

UPVC refers to an unplasticised polyvinyl chloride.

WAE refers to the Works as Executed Plan.

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

WSUD refers to Water Sensitive Urban Design.

SECTION 1 - GENERAL SPECIFICATIONS

1.1 PREAMBLE

This Construction Specification has been prepared for the guidance of Owners, Applicants, Supervisors, Consultants, Contractors and representatives thereof to outline Council's engineering standards for the construction of subdivisions and the development of land within the Camden Council area.

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

This Specification sets out the desirable and generally minimum construction standards relevant to development and is binding on all works carried out. Obligations between Council and the Applicant are inherent and binding once the Engineering Plans have been approved.

Variations to this specification may only be authorised by Council. Persons accredited or acting under the Environmental Planning and Assessment Act as a Principal Certifying Authority are specifically excluded from altering, adjusting or changing this specification in any way. In accordance with the Environmental Planning and Assessment Act, the Principal certifying Authority may rely on Construction, Compliance and Occupations Certificates, issued by an Accredited Certifying Authority.

Council's Design Specification for Subdivisions and Developments compliments this Construction Guide and shall be referred to for all design detail requirements.

1.2 ENGINEERING PLANS AND PRINCIPAL CERTIFYING AUTHORITIES

In this Specification, whenever the term 'Engineering Plan' is used, it shall be deemed to refer to plans associated with Construction Certificates issued by Council or the Principal Certifying Authority under the EP&A Act 1979, and Engineering Approvals issued by Council under the Roads Act 1993 and Local Government Act 1993.

Principal Certifying Authority's may issue Construction and Compliance Certificates for Subdivision and Development Works in accordance with the requirements of the EP&A Act 1979. Therefore any reference made in this Specification to approvals and inspections by Council for works under the EP&A Act 1979 shall also be deemed to be a reference to certificates issued and inspections carried out by Principal Certifying Authorities under the EP&A Act 1979.

Principal Certifying Authorities do not have the authority to issue Construction Certificates for existing or future work on public roads under the EP&A Act 1979.

Construction certificates and Compliance Certificates may be issued by a Private Certifying Authority.

1.3 SUPERVISION AND INSPECTIONS

1.3.1 Supervision

Nothing in this specification shall preclude all works being done in an efficient and workmanlike manner and in accordance with current engineering practice and principles. All works are to be completed in accordance with the drawings and specifications and with the engineering purpose and intent of the drawings and specifications.

After obtaining approved construction plans and specifications from Council (a copy of which will be kept on the job at all times) and any consents required from Statutory Authorities, the Supervisor may

construct the roads, drains and all other improvements comprising the development.

Before construction is commenced the Supervisor will ensure that adequate supervising staff is employed to control the work and to ensure that it is carried out fully in accordance with the requirements of the approved plans and specifications.

The supervisory staff will include a thoroughly reliable and competent person who has the necessary time, technical knowledge and experience to direct the work.

The Developer will advise Council of the name of the person appointed to supervise the work (hereinafter known as the supervisor).

1.3.2 Inspections by Council

The whole of the work shall be carried out to the entire satisfaction of the Council Engineer. The Supervisor shall at all times give uninterrupted access and afford every facility for the inspection and examination of any works or materials that may be instructed by the Council Engineer or any other person authorised by Council to examine them, and at any place where the said work or materials are being prepared.

The Supervisor, when required by Council, shall provide all particulars as to the mode, place of manufacture and source of supply of any of the materials to be used. Australian made goods and materials should be used in preference to imported goods.

The Supervisor shall at the direction of the Council Engineer submit any material or work for testing. The Supervisor will, when required by the Council Engineer, open up and supply samples of any work whether the same has or has not been previously approved by the Council Engineer. The cost of all tests required to be undertaken will be borne by the developer.

If at any time during the progress of the works, the Council Engineer is of the opinion that any materials or works, whether fixed or not, are of an inferior or improper description, a direction in writing to remove or amend the same will be made to the Supervisor.

All expenses incurred in removing or amending such materials or work, and to replace or amend the same with materials or work to the satisfaction of the Council Engineer shall be borne by the developer.

1.4 INSPECTION OF WORKS

The Supervisor must ensure that inspections are carried out at the following stages of construction. Council will assume the role of the Principal Certifying/roads authority. Additional inspections may be carried out as directed by Council.

- (a) Erosion and Sediment Control (refer to Section 11);
 - (i) Implementation of erosion and sediment control measures before construction;
 - (ii) Maintenance of erosion and sediment control measures during construction;
 - (iii) Removal of erosion and sediment control measures after construction;
- (b) Traffic Control (refer to Section 1.5);
 - (i) Implementation of traffic control measures before the works;
 - (ii) Maintenance of traffic control measures during works;
 - (iii) Removal of traffic control measures after the works;
- (c) Drainage (refer to Section 5);

- (i) Trench excavated, bedding material placed and pipes/conduits laid prior to backfilling;
- (ii) Filter material placed in subsoil drains prior to backfilling;
- (iii) Non-cohesive granular backfilling material prior to backfilling and after compaction;
- (iv) Drainage pits formed prior to placement of concrete;
- (v) Pit bases and headwall aprons with reinforcement and place prior to casting;
- (vi) Pit walls, wing walls and head walls with reinforcement and place prior to casting;
- (vii) Concrete pit tops;
- (viii) Connection to existing system prior to backfilling;
- (ix) Channel/watercourse tail out works after construction;
- (d) Pavement Construction (refer to Sections 7, 9 and 10);
 - (i) Sub-grade roller test (a visual check and roller test at the Council Engineer's discretion after the pavement design has been confirmed in writing);
 - (ii) Sub base roller test;
 - (iii) Base course roller test (a visual check and heavy truck at the Council Engineer's discretion, is required for concrete bases in small car parks, rights of carriageway and for private roads less than twelve (12) spaces);
 - (iv) Compaction test
 - (v) Kerb and gutter formed prior to placement of concrete where slip forming or a similar method has not been used;
 - (vi) Pavement ready for wearing courses; ;
 - (vii) Wearing course of pavement (i.e. AC or pavers);
- (e) Footpath, Off-road Cycleway and Shared Way Works (refer to Section 6.15);
 - (i) Footpath, cycleway, shared way and pathway trimming and/or turfing;
 - (ii) Concrete footpaths, cycleways, shared ways and pathways formed prior to placement of concrete;
 - (iii) Completed footpaths, off-road cycleways and shared ways construction;
- (f) On-site Detention System (OSD);
 - (i) Steel and formwork for tank/pit prior to placement of concrete;
 - (ii) Pipes upstream/downstream of tank/pit prior to backfilling;
 - (iii) Completion of OSD system;
- (g) Installation of Stormwater Quality Devices;
- (h) Overall final Inspections;

1.4.1 Notice for Inspections

The Supervisor shall provide the Council Engineer with 7-days notice prior to the commencement of work.

At least 48-hours clear notice (written correspondence preferred) should be given for the above inspections listed above. Failure to notify the need for an inspection may lead to the portion of the work not being approved by the Council.

The Supervisor shall not proceed to the next stage until the Council Engineer has approved the preceding stage of works.

In cases where a portion of the works is not approved, no further work may proceed whereby the failed portion of the work may become incorporated into any new works.

1.5 INSPECTION OF MATERIALS

All materials shall be subject to inspection, testing and approval by the Principal Certifying Authority. All materials used shall be the best of their respective kinds for the purpose for which they will be used. All wood and timber shall be thoroughly dry and well seasoned. All works of every description throughout shall be executed conformably to the Engineering Plans and specifications prepared or which may be prepared for the purpose in the strictest accordance with the provisions of this Specification and the best, most substantial and workmanlike manner.

1.5.1 Sampling and Testing of Materials

All materials incorporated into the work shall be subject to inspection, testing and approval by Council in accordance with Table 1.1.

The Supervisor, when required by the Council Engineer, shall submit any material or work for testing and shall 'open up' and supply samples of any work which has not been previously approved by Council. All costs associated with providing such materials or in making good the Works after such removal shall be borne by the developer.

Material samples furnished shall be representative of materials to be used. The Council Engineer may select samples or may require samples to be delivered to a Testing Officer appointed by Council at no cost to Council.

Where Council directs that materials be tested then such testing shall be done by a National Association of Testing Authorities (NATA) registered laboratory certified to undertake such testing. The cost of all material tests, including repeat tests as required, shall be borne by the developer.

The aforementioned testing does not relieve the developer's responsibility to ensure that the requirements of this Specification are adhered to and in this regard the Supervisor shall carry out such control testing deemed necessary.

Table 1.1 Schedule of Material Testing

MATERIAL	STANDARD TO BE COMPLIED WITH	HOLD POINT	FORM OF TEST VERIFICATION
Concrete	AS3600	Concrete pour	Manufacturers certification
Ready Mixed Concrete	AS1379	Concrete pour	NATA Certificate
Hardened Concrete	AS1012	7-day, 28-day strength	NATA Certificate
Reinforcing Bars/Wire	AS/NZS4671	Concrete pour	Manufacturers certification
Interlocking Concrete and Clay Paver Units	AS/NZS4456	Taking delivery	NATA Certificate
Precast Reinforced Box Culvert	AS1597	Taking delivery	Manufacturers certification
Pipes	As for pipe type	Taking delivery	Manufacturers certification
Compacted Sub-grade	AS1289, AS3798	Pavement construction	Proof rolling, NATA Certificate and Plan
Compacted Sub base	AS1289, AS3798	Placing base course	Proof Rolling, NATA Certificate and Plan
Compacted Base Course	AS1289, AS3798	Road surfacing	Proof Rolling, NATA Certificate and Plan
Asphaltic Concrete	AS2891, RTA T612	Completion of asphalt works	NATA Certificate
Earth Fill	AS1289, AS3798	Taking delivery	NATA Certificate and Plan
Crushed Rock	RTA QA 3051, RTA T114, T213, T215, T221, T276	Taking delivery	NATA Certificate
Natural Gravel	RTA T106, T114, T108, T109, T215	Taking delivery	NATA Certificate

1.5.2 Removal of Unsuitable Materials or Improper Works

If at any time during the progress or after completion of the works, the Council Engineer is of the opinion that any materials or works, whether fixed or not, are of an inferior or improper description, a direction in writing to remove or amend the same will be made to the Supervisor, notwithstanding that Council may previously have expressed satisfaction in regard thereto. The Supervisor shall be bound to comply with such direction within 24-hours.

All expenses incurred in removing or amending such materials or work, and to replace or amend the same with materials or work to the satisfaction of the Council Engineer shall be borne by the developer.

1.6 NOTICES TO BE IN WRITING

All notices, applications, variations and requests are to be given to the Principal Certifying Authority in writing.

1.7 INSURANCE

1.7.1 Public Liability Insurance

The Owner/Applicant must ensure that Supervisors/Contractors engaged on Subdivision,

Development Works (under the EP&A Act) or Road Works (under the Roads Act 1993) have a current Public Liability Insurance Policy to the value of at least \$20 million unless otherwise specified by Council. The policy must show Council as an interested party and shall specifically indemnify Council from all claims arising from the execution of works. Prior to commencement of works, the Owner/Applicant must submit proof of Public Liability Insurance to Council for the whole of the works.

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

1.7.2 Workers Compensation

The Owner/Applicant must ensure that Supervisors/Contractors engaged on Subdivision and Development Works (under the EP&A Act) or Road Works (under the Roads Act) have current Workers Compensation Insurance Policies for all employees as required by Statute. Prior to commencement of works, the Owner/Applicant must submit proof of Workers Compensation Insurance to Council for the whole of the works.

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

1.7.3 Professional Indemnity Insurance

The Owner/Applicant must ensure that all Supervisors/Contractors engaged on Subdivision and Development Works (under the EP&A Act) or Road Works (under the Roads Act) have the appropriate level of Professional Indemnity Insurance. Prior to commencement of works, the Owner/Applicant must submit proof of Professional Indemnity Insurance to Council for the whole of the works.

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

1.8 TRAFFIC CONTROL FOR WORK IN PUBLIC ROADS

A 'Traffic Control Plan' must be prepared by a suitably accredited RTA work site traffic designer for all works that are carried out in or adjacent to a public road, satisfying all the requirements of AS1742.3 'Traffic Control Devices for Work on Roads' and the RTA's 'Traffic Control at Worksites Manual'. The Supervisor must ensure that the 'Traffic Control Plan' is submitted to Council for approval. No works shall commence until the 'Traffic Control Plan' has been considered by Council.

Where works are to be carried out on a Council road, a Road Opening Permit and Roads Act Approval must be obtained from Council and an appropriate fee paid prior to any works being undertaken. Council must be notified the day before the works are to take place.

Where works are to be carried out on an RTA road, a Road Occupancy License, a Road Opening Permit and Roads Act Approval must be obtained from the RTA prior to any works being undertaken.

It is the responsibility of the Supervisor to have in place and maintain traffic facilities in accordance with the 'Traffic Control Plan', at all times, day and night, 7-days a week for the duration of the works. The installed traffic facilities must be verified as being consistent with the approved plan by suitably accredited RTA work site traffic designers.

The Supervisor's traffic control operations must minimise any side road or branch track. It must not break down any fences, damage public or private utilities, communication lines nor obstruct any drain or watercourse. When obstructions or breakages cannot be entirely avoided, the Supervisor shall at once remove such obstructions, immediately repair such breakages and make adequate provision for traffic. In the event of the Supervisor failing to rectify any of the abovementioned causes, Council reserves to itself the power to do so after giving the Supervisor 24-hours notice in writing of its intention. The whole of the cost of such work incurred by Council will be a legitimate charge payable

by the Supervisor.

The developer of the traffic control plan shall be responsible for the inspection of the installed controls.

Notwithstanding the above requirements, the traffic control provisions provided in the following Sections shall be adopted in relation to specific components of work.

1.8.1 Pavement Construction

In public road reserves, as soon as the Council Engineer has undertaken the final pavement inspection and approved the works completed, the Supervisor shall permit traffic to use the section. Any precautions to render conditions safe for traffic, required on account of the incompleteness of the remainder of the works, shall be carried out by the Supervisor or as instructed by the Council Engineer, in accordance with AS1742.3 'Traffic Control Devices for Work on Roads' and the RTA's 'Traffic Control at Worksites Manual'. The responsibility for pedestrian and motorist safety remains with the Supervisor.

Traffic shall not be permitted to use the pavement until it is fully compacted and where applicable, cured. If required by the certifying/roads authority during the construction of the pavement, the Supervisor shall provide for traffic by its diversion to an alternative route approved by the Council Engineer, or by the formation of side tracks alongside the work, or by the construction of half of the road at a time leaving the other half available for traffic. Except in an emergency situation, diversion by an alternative route or provision of a half road for traffic requires the approval of Council's Traffic Committee.

After the pavement is fully compacted it may be opened to traffic, provided that, in the opinion of the Council Engineer, it will not suffer damage. Notwithstanding such approval, any damage which may occur shall be made good by the Supervisor or Council at the developer's expense.

1.8.2 Sprayed Bituminous Surfacing

All claims arising from the marking of vehicles by binder shall be the responsibility of the Supervisor.

The Supervisor must ensure that certificates of currency of the relevant insurances are provided to Council prior to the commencement of any works, in accordance with Section 1.7 of this Specification, to protect Council from any costs associated with such claims and any compensation arising there from. The cost of all such claims and any compensation arising there from shall be met by the developer.

1.8.3 Asphaltic Concrete

Special care shall be taken to ensure that vehicles and pedestrians are not sprayed with bitumen emulsion during tack coating, and that entry to areas treated with tack coat or hot asphaltic concrete is prevented.

The Supervisor must ensure that certificates of currency of the relevant insurances are provided to Council prior to the commencement of any works, in accordance with Section 1.7 of this Specification, to protect Council from any costs associated with damages caused by the application of asphaltic concrete and any compensation arising there from. The cost of all such damages and any compensation arising there from shall be met by the developer.

1.9 LIGHTING OF FIRES

All burning is prohibited within the Camden Council area unless approved otherwise by Council in accordance with the Protection of the Environment Operations (Control of Burning) Regulation (2000).

The Supervisor shall be responsible for all damage to fences, grass, cultivation, buildings or other property occasioned by fires that occur on the developer's land or that are lit for any approved purpose in connection with the development.

The Supervisor shall give the occupiers of adjoining properties 48-hours notice of the intention to light a fire.

1.10 WORK BY SERVICE SUPPLY AUTHORITIES AND/OR OTHER CONTRACTORS

It should be anticipated by the Supervisor that the construction of mains and/or services by Utility Authorities and/or work by other Contractors may proceed during the currency of the work.

The Supervisor shall permit and maintain access by traffic to such construction and/or work and shall not obstruct the execution of work by the various public utility Service Authorities and/or other Contractors.

1.11 EXISTING PIPES, SEWERS AND OTHER SERVICES

1.11.1 Care of Existing Works

Prior to the commencement of the works the Supervisor shall ascertain from the appropriate Utility Authorities and/or Local Government Authorities, the position and depth of all public utility or other services which may be interfered with during the excavation and/ or construction of the works. The Supervisor shall take every precaution to secure from damage all existing gas and water mains, gas and water service pipes, stormwater drainage lines, sewers, electrical conduits, telephone installations, or other existing works, or services wherever met with, in the area of the work or which are adjacent to the works and shall maintain the same, until the backfilling of excavations and the general progress of the works render such further precautions unnecessary.

All damage caused in the execution of works to any water and gas main, gas and water services pipes, stormwater drainage lines, sewers, electrical conduits, telephone installations or other existing works or services, shall be repaired at once and the Supervisor shall arrange with the appropriate authority for the removal or deviation of such existing works at the developer's expense. The developer is responsible for any costs associated with the downtime of any damaged services.

1.11.2 Relocation of Existing Services

Where it is found necessary to remove, divert or cut into any existing drain, gas or water main, gas or water service pipes, stormwater drainage line, sewer, electrical conduit, telephone installations or other existing work or service the Supervisor shall arrange with the appropriate authority for the removal, deviation of, or connection to such existing works at the developer's expense.

1.12 DIVERTING WATER AND DEWATERING

The Supervisor is responsible for diverting any surface and/or subsoil water from interfering with the progress of the works. The Supervisor is responsible for keeping the works free from such water and shall take all reasonable measures to prevent any injury to the works by water due to flood seepage or other causes.

Any work or material damaged by water from any source shall be taken up, replaced with fresh material and reconstructed by the Supervisor, at the developer's cost, to the satisfaction of Council.

1.13 ENTRANCE TO SIDE ROADS AND ADJACENT PROPERTY

Should any alteration to levels be made adjacent to entrances to side roads or vehicular entrances to adjacent properties, adjustment to restore access shall be carried out as detailed on the Engineering Plans. If not detailed on the Engineering Plans, access shall nevertheless be restored by uniformly regrading the entrance from the outer edge of the new formation, either on a grade of 1(V):6(H) until it meets the existing formation, or to the line (or produced line) of the road boundary, whichever is the lesser distance. The formation and pavement of the entrance shall be reinstated at least equal in width, depth and quality to that previously existing.

Suitable access shall be maintained to such side roads or adjacent properties to the satisfaction of Council. Entrances for pedestrians shall be restored to a condition equal to that previously existing.

Where fences are disturbed or destroyed, restoration shall be carried out by the Supervisor, at the developer's expense, to a condition at least equal to that previously existing, unless otherwise specified or detailed on the Engineering Plans.

1.14 CARE OF SURVEY MARKS

The Supervisor shall preserve and maintain in their true position all State Survey Marks (SSM) and Permanent Marks (PM) whether or not the marks are to be used for the purpose of setting out, checking or measuring the work.

Should any SSM or PM be disturbed or removed, the Supervisor shall arrange for a Registered Surveyor to rectify or remove such disturbance to the satisfaction of Council. The Supervisor shall report the removal or disturbance of any SSM or PM to the Surveyor Generals office. The cost of rectification shall be borne by the developer.

The Supervisor must provide a sketch plan showing Northing and Easting coordinates in MGA format with ties to existing boundaries and Bench Marks to AHD, for any disturbed or relocated SSM or PM.

1.15 EXCAVATION

Wherever appearing in this Specification 'excavation' shall mean excavation in all classes of materials and shall include the removal of loose earth, sand, clay, all growth, shale, igneous, metamorphic and sedimentary rock, ironstone, concrete, masonry, pipes, conduits, made ground and any other obstruction, material, matter or substance.

The Supervisor shall excavate to the depths and dimensions shown or implied on the Engineering Plans, or to such greater depths and dimensions, as will ensure permanent foundations. All excavation shall be inspected and approved by Council before any materials or structures are placed thereon. Refer to Section 1.4 for inspection requirements.

Excavated material, if deemed suitable by Council, shall be used in the formation of embankments and for site filling.

In carrying out excavation work, the Supervisor shall take all the precautions against the mishap or accident, whether arising from insufficient strength of timbering, bad workmanship, breakage of machinery or plant, inefficient caulking or packing of open joints or spaces, flood, or any other cause whatsoever, and shall be held responsible for all damage, injury or loss that may be occasioned to buildings, structures, bridges, railways, tramways, roadways, streets and other surfaces above and adjacent to the excavations, to all persons whether employed by the developer, by Council or otherwise. The Supervisor must ensure that certificates of currency of the relevant insurances are provided to Council prior to the commencement of any works, in accordance with Section 1.5 of this

Specification, to protect Council from any costs associated with such damage, injury and loss and any compensation arising there from as a result of the development. The cost of all such damage, injury and loss and any compensation arising there from shall be met by the developer.

The surfaces of any exposed rock shall be dressed to finished lines with picks and scrubbling tools so as to remove all loose and shaken rock, leaving the surface firm and regular. Excavation shall be taken out as neatly as possible to the dimensions shown and any inequalities shall be made good unless otherwise specified or directed.

1.16 IMPORTED SELECTED FILLING

The Supervisor shall provide and import on to the site all filling required in excess of the amount available from the excavations and shall make arrangements for obtaining suitable filling from sources outside the limits of the site.

The Supervisor shall give Council 7-days clear notice of the intention to import filling and shall indicate in such advice the source of the material proposed to be used.

. A contamination report prepared by an NATA Registered Laboratory shall be provided to Council prior to the placement of any imported fill in accordance with Section 1.5.1 of this Specification. Where that material is virgin excavated natural material (VENM) it shall be provided and imported on to the site and shall be certified as VENM in accordance with AS1289 'Methods of Testing Soils for Engineering Purposes' and AS3798 'Guidelines on Earthworks for Commercial and Residential Developments'

All imported fill delivered to the site shall be recorded in a delivery register kept onsite. All filling delivered which fails to meet the requirements of this document, shall be immediately removed from the site by the Supervisor, at the developer's expense.

Unless authorised in writing by Council, no unspecified excavation shall be carried out within the site for the purpose of obtaining material for filling operations.

1.17 BACKFILL AT STRUCTURES

Unless shown on the Engineering Plans or otherwise specified, all filling for a distance of 2-metres back from abutments and wings of bridges or box culverts shall consist of approved granular material. This material and that at any other place where compaction by rolling is impracticable shall be compacted by thorough watering and ramming in layers not more than 150 mm in thickness, the rammers to weigh not less than 20 kg and to have not more than 150 gm per square centimetre of contact area.

1.18 SHAPING OF EARTHWORKS

Embankments and excavations shall be evenly graded in accordance with the Engineering Plans with surfaces and side slopes neatly and evenly graded and trimmed.

1.19 STONE PITCHING

Where indicated on the Engineering Plans, embankments shall be protected from washing or slipping by hand placed pitching stones. The stone pitching shall be of durable stone, hammer dressed and of at least one thirtieth (1/30) cubic metre in volume. Alternatively, rectangular blocks of 1:3:6 concrete one thirtieth (1/30) cubic metre in volume may be used. The stones shall be placed in courses with their beds at right angles to the slope, the larger stones being used in the bottom, and the smaller ones at the top. The minimum thickness of the wall at right angles to the slope shall be 250 mm. The

stones shall be laid in close contact so as to create joints with the weight of all stones being carried by the filling and not by adjacent pitching stones.

The spaces between the stone shall generally not exceed 10 mm in any case. The finished wall shall present an even, tight and reasonably smooth surface of the required contour.

1.20 RETAINING WALLS

Where indicated on the Engineering Plans, retaining walls shall be constructed. Retaining walls greater than 900 mm in height must be constructed to a suitably accredited 'Structural' certifying engineer's detail.

1.21 GUIDE AND/OR INDICATOR POSTS

Guides and/or indicator posts shall be placed in positions as shown on the Engineering Plans and be in accordance with RTA Specification 131 "Guide Posts" or as directed by Council.

Timber posts shall be approved hardwood free from imperfections and shall comply with RTA Specification 3411 'Supply of Guide Posts - Timber'. Plastic posts shall comply with RTA Specification 3412 'Supply of Guide Posts - Non-Timber'.

The earth backfilled around timber and plastic posts shall be well rammed in layers of not more than 150 mm for the full depth to the satisfaction of Council. One (1) red reflector shall be attached to each face of timber and plastic posts opposed to traffic. The reflectors shall consist of 100 mm by 50 mm strips of red retro reflective material. White retro reflectors shall also be attached to the reverse face of the posts.

1.22 SIGNS AND STENCILLING

1.22.1 Street Name Signs

Street name signs shall be installed in positions shown on the Engineering Plans or as directed by Council. Council will direct the Supervisor as to which standard is to be adopted.

Reference is to be made to Council's 'Design Palette' for specific types, sizes, colours and fonts of street signs applicable in the Camden Council area.

1.22.2 Traffic Control Signs

Traffic control signs shall be erected in positions shown on the approved Traffic Management Plan and shall be provided in accordance with AS1742.1 'General Introduction and Index of Signs'.

1.22.3 Lot and House Number Stencilling

Lot and house numbers are to be stencilled on the kerb face for all new developments where kerb and gutter is provided. Reference is to be made to Council's 'Design Palette' for specific stencil types, sizes, colours and fonts applicable in the Camden Council area.

1.23 UTILITY AND SERVICE CONDUITS

All conduit trenches shall be constructed in accordance with the requirements of the service authority

and shall adhere to the outcome of the Roads Opening Conference.

Conduits under roads shall be laid prior to the construction of the initial course of the pavement unless otherwise approved by Council. The required conduits shall be laid with a minimum cover of 750 mm under roads, or as otherwise required by the relevant Utility Authority, and shall extend to a point a minimum of 0.3-metres behind the kerb faces or edge of shoulder.

Backfill material under road pavements shall comply with the requirements of pipe bedding in Section 5.5 of this Specification. Backfilling and compaction shall comply with the requirements Section 5 of this Specification.

1.23.1 Electricity Conduits

Electricity conduits shall be excavated for, supplied unless otherwise specified, bedded, laid, jointed and backfilled in Council approved locations on the Engineering Plans and shall be to the requirements of the relevant Electricity Authority.

The ends of the conduits shall be plugged or suitably sealed to preclude entry of soil and shall be connected with approved fittings.

The Supervisor shall arrange for all conduits to be inspected and approved by the appropriate relevant Electricity Authority.

Kerb faces shall be permanently marked at conduit crossings directly above the conduit to the requirements of the appropriate Authority and by a peg at the end of a conduit run where kerbing has not been constructed. Marking shall be to the requirements of the appropriate relevant Electricity Authority.

1.23.2 Water Supply Conduits

Where approved by Council, the Supervisor shall supply, excavate for, lay, joint and backfill water supply conduits in carriageways and pathways in accordance with the relevant Water Authority requirements.

The location of the conduits shall be marked by cutting the letter 'W' 75 mm in height in the concrete kerb face or concrete edge at each end of the conduit unless otherwise directed by Council.

The water supply conduit provided may be any of the following as shown in Table 1.2:

Table 1.2 Nominated Water Supply Conduits

CONDUIT TYPE	DIAMETER	COMPLIANCE
Copper Tube – Type B	20 mm	AS1432 'Copper Tubes for Plumbing, Gas-fitting and Drainage Applications'
UPVC Conduit	50 mm, 80 mm, 100 mm	AS2053 'Conduits and Fittings for Electrical Installation'
RC Pipe – Class Y	100 mm	AS4058 'Precast Concrete Pipes (Pressure and Non-pressure)'

When 20 mm diameter copper tube is nominated, the conduit shall be laid in one (1) continuous length of solid drawn pipe, unless otherwise approved by Council and capped to the satisfaction of the relevant Water Authority or the Council Engineer. The installation shall be carried out by a recognised Contractor of the relevant Water Authority.

If connected to an existing water supply main, a testing certificate is required to the satisfaction of

Sydney Water.

1.23.3 Telephone Conduits

The Supervisor shall liaise direct with the local construction office of the relevant Telecommunications Authority to ensure that the necessary road crossings are installed prior to placing kerb and gutter. Kerb faces shall be permanently marked at crossing directly above the conduit to the requirements of the relevant Telecommunications Authority.

1.23.4 Gas Conduits

The Supervisor shall excavate for, bed, lay, joint and backfill gas conduits in locations nominated by the relevant Gas Authority. The location of the conduit shall be marked by cutting the letter 'G' 75 mm in height in the concrete kerb face at each end of the conduit.

1.23.5 Trenchless Installation

The provision of utilities and services under all existing Council roads shall be undertaken using a trenchless installation technique unless otherwise approved by the Council Engineer.

Construction for new utility and service installations shall be by means of thrust boring, pipe-jacking, directional drilling, micro tunnelling, impact rolling or other non-surface disruptive construction.

Renovation of existing utilities and services and pipe replacement shall be by means of thrust boring, pipe-bursting or pipe extraction/replacement or other non-surface disruptive construction.

The Supervisor is to supply all materials and plant for the work.

Where the provision of utilities and services requires the crossing of existing Council roads using trenchless installation techniques, the following requirements shall apply:

- (a) Steel encasing pipes are to be fabricated from steel having specified minimum yield strength of 230 MPa and will have a minimum wall thickness of 8 mm for inside diameters less than or equal to 450 mm or 12 mm for encasing pipes of inside diameter greater than or equal to 800 mm;
- (b) Reinforced concrete encasing pipes are to comply with AS4058 'Precast Concrete Pipes (Pressure and Non-pressure)' with the minimum class of pipe to be Class 4;
- (c) The inside diameter of the encasing pipe is to be at least 100 mm greater than the largest diameter of the new utility or service conduit as measured at the joint or coupling;
- (d) The Supervisor shall provide pipe support cradles to support the utility or service conduit at the required grade with the first and last cradles to be located within 1000 mm of each end;
- (e) After installation and testing, the annular space between the utility or service conduit and the encasing pipe is to be completely filled with grout mix. The utility or service conduit is to be filled with water during grouting with all precautions taken to ensure no movement of the new utility or service conduit from its line or grade; and
- (f) Grout is to be used for sealing of the annular space and is to be a mixture of cement and water plus an admixture if specified.

Where provision of utility or service conduits requires crossings of main roads or railway property the requirements of the relevant Utility, Roads and Rail Authorities shall be sought and complied with.

1.24 REINSTATEMENT

Prior to final approval by Council, all surplus material and rubbish shall be removed and the whole of

the site left clean and neat in appearance. Any road pavement, footpath or kerb and gutter disturbed or destroyed during construction shall be reinstated to a condition at least equal to that existing before commencement of operations. Advice must be sought from Council's Assets Branch as to its requirements before the restoration work is carried out.

Any areas external to the site which become fouled or damaged either by construction traffic or natural causes such as dirt laden stormwater runoff shall be cleaned by the Supervisor as directed by Council and at no cost to Council.

Similarly, the whole work shall be left in a neat and tidy condition at the end of the Maintenance Period.

1.25 WORK AS EXECUTED PLANS

As directed by Council and upon satisfactory completion of engineering works in the development a 'works-as-executed' plan shall be prepared in accordance with Section 13.1 of this Specification by a Registered Surveyor and forwarded to Council prior to release of linen plan of subdivision or final approval of development.

1.26 BONDS

Council's development procedures provide for the lodgment of Bonds in relation to the following construction activities:

- (a) Maintenance of the infrastructure associated with Subdivision or Development Works;
- (b) Incomplete infrastructure works associated with Subdivision and Development Works; and
- (c) Damages to existing infrastructure due to Subdivision or Development Works.

The rates for the Bonds listed below are provided in Council's Annual Fees and Charges. An administration fee will be charged in addition to each Bond.

Upon written request from the Owner/Applicant and satisfactory completion of the Maintenance Period, or completion of the works (whichever is the case), the Bond or any amount remaining will be released by the Council.

1.26.1 Maintenance

Prior to the approval of the construction works, the Supervisor shall lodge with Council a bond to provide for the satisfactory performance of works and the replacement of any failed or unsatisfactory work and any repairs required, inclusive of the maintenance of any traffic control facilities.

The bond will be calculated as 125% of the contract cost for the bonded works. The bond will be held by the Council for a Maintenance period of twelve (12) months and shall commence from the date of issue of the Subdivision Certificate or at the practical completion of works (for other developments). During this time the Supervisor is responsible for maintenance of the works.

If the Supervisor fails to maintain the works to the satisfaction of the Council Engineer, then the Bond may be used to render the works satisfactory to the Council Engineer and any unexpended balance refunded.

In the event that the Bond is insufficient to meet the maintenance cost, the difference shall become a charge on the developer which may be recovered by the Council.

1.26.2 Incomplete Works

Where Council considers the carrying out of works is not necessary prior to the issue of a subdivision certificate, Council will accept the lodgment of a bank guarantee to ensure completion of that work.

Where in the opinion of the Council Engineer, the Works can be completed prior to issue of the Subdivision Certificate, then those works must be completed.

Examples of where Council will accept a bank guarantee are:

- Final wearing course
- Street Trees and furniture
- Line marking and
- Signage

The Bond will be held by Council until all deferred Subdivision and Development Works have been completed to the satisfaction of the Council Engineer and shall commence from the date of issue of the Subdivision Certificate or at the practical completion of works (for other developments).

In the event that the Bond is insufficient to meet the cost of completing the infrastructure works, the difference shall become a charge on the developer which may be recovered by Council.

Bonds will be calculated in accordance with the costs detailed in Council's adopted Fees and Charges.

1.26.3 Damage to Existing Infrastructure

Prior to the commencement of the construction works, the developer shall lodge with Council a Bond to provide for satisfactory restoration of existing infrastructure damaged as a result of construction activities associated with the Subdivision and Development Works.

The Bond will be held by Council until all Subdivision and Development Works have been completed to the satisfaction of the Council Engineer.

In the event that the Bond is insufficient to meet the cost of restoring existing infrastructure works, the difference shall become a charge on the developer which may be recovered by Council.

SECTION 2 - SITE CLEARING

2.1 DESCRIPTION

This Specification outlines the requirements for the clearing and/or grubbing and removal of prescribed materials from the full area of the site specified or shown on the Engineering Plans.

2.2 NOTICE OF COMMENCEMENT

The Supervisor shall give Council 7-days written clear notice of the intention to commence clearing operations, and no work shall be commenced within that period unless approval to do so has been granted by Council.

2.3 CLEARING AND GRUBBING

All tree and environmental protection measures detailed in the Erosion and Sediment Control Plan must be implemented prior to the commencement of any site clearing and grubbing.

For the full area of the site specified or shown on the Engineering Plans the prescribed materials, being fences, concrete and/or brick foundations, and/or floors, structures of all descriptions, trees, shrubs, scrub, stumps, logs, boulders and roots (except those fences, structures, trees, shrubs and/or items which Council may direct to be retained) shall be cleared and/or wholly grubbed, and together with all lying and fallen timber, rubbish and debris of every description, shall be disposed of in accordance with the provisions of Section 2.6 of this Specification .

2.4 VEGETATION

No trees shall be destroyed or damaged within a construction unless development consent has been obtained.

2.5 CARE OF TREES THAT ARE TO BE RETAINED

Trees and/or shrubs to be retained are to be adequately protected at all times and particular care shall be taken to avoid any damage to the roots, trunks and branches. If necessary for this purpose, equipment shall be kept clear of trees and/or shrubs and hand methods of excavation shall be adopted to avoid damage.

2.5.1 Breathing Layers

Where directed, trees in more than 0.3-metres of fill shall be provided with a breathing layer.

2.5.2 Roots

Before any excavation is carried out over the roots of trees and/or shrubs to be retained, the Supervisor shall obtain a direction from Council as to whether the levels in the vicinity of the tree can be adjusted to protect the roots. Any costs associated with such a direction will be borne by the

developer.

When any excavation is required in the vicinity of trees identified to be retained, hand excavation shall be undertaken first to locate any roots (roots shall not be cleared). Roots which are then seen to be affected by the line of the proposed work shall be cleanly severed/cut clear of the work before machine excavation commences.

2.5.3 Branches

Where branches of trees marked to be retained protrude into the working area so that these cannot be avoided, arrangements shall be made on approval by Council for their removal by the Supervisor.

If in the opinion of Council any tree or shrub to be preserved contains branches which are dangerous, such branches shall be removed and disposed of in accordance with the provisions of Section 2.6 of this Specification.

2.5.4 Trunks

If considered necessary, Council may direct the Supervisor to protect the trunks of trees marked to be retained. This protection shall be given by lashing pine off cuts upright around the trunks leaving gaps of no more than 150 mm. The off cuts shall be 1.5-metres high and shall extend down to ground level so as to protect the tree trunk. The flat side of the off cuts shall face outwards and if necessary shall be painted white.

2.5.5 Damage to Trunks

Where the trunks of trees are slightly damaged by equipment, in lieu of replacement, Council may direct the Supervisor to effectively cover the damaged portion of the trunk with approved tree paint. The Supervisor shall carry out this work in a satisfactory manner within 48-hours of being so directed by Council. Any costs associated with such works shall be borne by the developer.

2.6 DISPOSAL OF MATERIAL

All material cleared and/or grubbed in accordance with this Specification shall become the property of the Supervisor, who shall adhere to the provisions of the relevant State legislation.

In accordance with Protection of the Environment Operations (Control of Burning) Regulation (2000) all burning is prohibited within the Camden Council area unless approved otherwise by Council.

Accordingly the lighting of fires and burning in the open is NOT permitted and all material cleared and/or grubbed shall be removed from the site or prepared into mulch for reuse. All associated costs shall be borne by the developer.

SECTION 3 - SITE PREPARATION WORKS

3.1 DESCRIPTION

This Specification applies to all areas of the Site indicated on the Engineering Plans and outlines the requirements for the site preparation of building allotments and/or reserves, inclusive of site regrading.

3.2 REMOVAL OF TOPSOIL

Topsoil shall be stripped from within the formation areas of roads, driveways, parking areas, pathways, batter areas and other associated works and shall be stockpiled in approved locations identified on the Erosion and Sediment Control or Soil and Water Management Plans for future top dressing of formed footways, berms, batters or site regrading areas.

The thickness of the topsoil stripping shall be as shown on the Engineering Plans or, where no depth is specified to a minimum depth of 100 mm.

All topsoil stockpiles shall be maintained in a neat and tidy condition during the execution of the works and until replacement of topsoiling is carried out in accordance with Section 3.6 of this Specification. Care shall be taken to avoid contamination of the stockpiles by any other matter.

3.3 PREPARATION PRIOR TO FILLING

On areas of the site which will ultimately become road reserve and which are required to be regraded by filling in excess of 300 mm, after removal of the material and before any filling is placed, the stripped surface shall be compacted to a dry density ratio of not less than 95% of its standard maximum dry density. Such stripped areas shall be tested and certified by a NATA Registered Laboratory and results confirming conformance provided to Council prior to placement of the fill.

On all other areas of the development site, if in the opinion of Council soft, unstable or wet patches are encountered at the excavation level, the material shall be tined, drained, recompacted and proofed rolled prior to filling in accordance with the provisions of Section 3.6 of this Specification.

If the surface has dried and shrinkage cracking has occurred, the surface shall be watered by sprinkling with an approved sprayer which gives a uniform distribution of water over the whole area. Council may direct that the material be also tined and recompacted in accordance with the provisions of Section 3.7 of this Specification if the watering has not closed up the shrinkage cracks.

3.4 REMOVAL OF UNSUITABLE MATERIALS

Following the removal of topsoil as specified Section 3.2 of this Specification and before the specified filling is commenced in any area the Supervisor shall remove all exposed deleterious materials including vegetation, roots and stumps which, in the opinion of Council, are unsuitable for the placing of filling.

All unsuitable material shall be disposed of by the Supervisor, at the developers expense, to the satisfaction of Council.

3.5 REGRADING

The Supervisor shall carry out the site regrading works shown on the Engineering Plans in accordance with the requirements of this Specification.

Specified regrading work shall be carried out by cut and/or fill, and/or by utilisation of surplus spoil from road formation and drainage works. Where insufficient filling is available from these sources, the Supervisor shall import onto the site the required additional filling in accordance with the provisions of Section 1.18 of this Specification. Prior to the completion of each day's operation, a lip at the top of the formation shall be provided such that surface water is drained away from the face of the batter.

The areas specified to be regraded shall be finished to the levels, with allowance for topsoil replacement, and/or grades shown on the Engineering Plans without abrupt changes of slope and/or depressions, which may hold surface waters. The regraded surface, after the specified compaction shall present a good true surface, free from rocks, clods and rubbish of all description to the satisfaction of Council's Engineer.

All areas not subject to construction works shall be retained free from disturbance or damage. Should these areas become disturbed or damaged they shall be reinstated by the Supervisor to a condition at least equal to that existing before commencement of operations prior to final approval by Council.

3.6 PLACING AND COMPACTION OF FILL

In road reservations the placement of filling on the prepared areas shall not commence until the authority to do so has been obtained from Council.

Filling shall be carried out in horizontal layers, extending the full width of the area being filled, not more than 250 mm thick, compacted measurement.

Each layer of the fill shall be compacted to a dry density ratio (AS1289.5.4.1 'Dry Density Ratio, Moisture Variation and Moisture Ratio') of not less than 100% standard in road pavement areas and 95% standard in all other areas using the in-situ dry density determined in AS1289.5.3.1 'Determination of the Field Density of a Soil - Sand Replacement Method Using a Sand-Cone Pouring Apparatus', after applying the correction for oversize given in AS1289.5.3.1 and the laboratory compaction method given in AS1289.5.1.1 'Determination of the Dry Density/Moisture Content Relation of a Soil Using Standard Compactive Effort'.

The compaction of all filled areas in excess of 300 mm must be tested and certified by a NATA Registered Laboratory.

The coordination of compaction testing including the placement, supervision, inspection and frequency of testing, shall be carried out in accordance with AS3798 'Guidelines on Earthworks for Commercial and Residential Developments – Appendix B, Level 2 Testing' as a minimum standard.

During compaction of each layer, the moisture content of the minus 19 mm fraction of the fill as placed shall not be more than plus 3% nor less than minus 3% from the optimum moisture content as defined by AS1289.5.1.1 'Determination of the Dry Density/Moisture Content Relation of a Soil Using Standard Compactive Effort'.

If it is necessary to increase the moisture content, the layers shall be watered by sprinkling with an approved sprayer which gives a uniform distribution of water over the whole area. Sufficient watering equipment shall be available at all times during compaction operations.

If the material is too wet to permit proper compaction, the Supervisor may work the material to assist the drying process. Compaction shall be delayed until it has dried to the required moisture content.

Areas which have dried out, wetted excessively or have become loosened by trafficking of equipment during compaction operations shall be removed, the voids being filled with approved material blending

with that adjacent and compacted in accordance with the provisions of this Section. It is the responsibility of the Supervisor to arrange the required inspections and retesting of the replaced portion of work.

3.7 REPLACEMENT OF TOPSOIL

The Supervisor shall not commence placing the topsoil on the prepared areas until the authority to do so has been obtained from Council.

The Supervisor shall spread stockpiled and/or imported topsoil to the specified depth. Where no depth is specified the topsoil shall be spread to a depth of not less than 100 mm.

After spreading the topsoil, it shall then be firmed, levelled and trimmed so that the finished surface of the topsoil conforms to the design levels and grades unless otherwise specified or directed.

Topsoiled areas, when finished, shall present smooth surfaces free of stones, lumps of soil and shall be gradually blending into adjoining undisturbed ground to the satisfaction of the Council Engineer. Weed removal is to be undertaken on topsoiled area, after finished levels are established and a sufficient period has elapsed to allow any weed regrowth to occur. Disturbed areas shall be stabilised and turfed or spray turfed to the satisfaction of the Council Engineer.

SECTION 4 - FORMATION

4.1 DESCRIPTION

This Specification outlines the requirements for the formation by cut and/or fill of the earthworks for the construction of roads, pathways and miscellaneous pavements and for the execution of other works appurtenant thereto. The Supervisor shall execute the formation of the earthworks and of the other works appurtenant thereto in strict conformity with the Engineering Plans and to the requirements of this Specification.

4.2 EXCAVATION

Excavation shall be carried out in to the depths and dimensions shown on the Engineering Plans, or to such depths and dimensions that will ensure permanent foundations, in accordance with the provisions of Section 1.15 of the Specification.

Any over excavation shall be made good with approved granular material or other approved filling placed in layers not exceeding 250 mm thickness, loose measurement, and each layer shall be compacted in accordance with Section 4.5 of this Specification.

Excavated material, if deemed suitable by Council, may be used in the formation of embankments and for site filling.

In carrying out excavation work, all reasonable precautions against mishap or accident shall be taken, and the Supervisor shall be held solely responsible for all damage, injury or loss that may occur to buildings, structures, bridges, railways, roadways, streets and to all persons whether employed by the Supervisor, by Council or otherwise.

The Supervisor must ensure that certificates of currency of the relevant insurances are provided to Council prior to the commencement of any works, in accordance with Section 1.7 of this Specification, to protect Council from any costs associated with such damage, injury or loss and any compensation arising there from. The cost of all such damage, injury or loss and any compensation arising there from shall be met by the developer.

4.3 IMPORTED FILLING

All imported filling provided shall be in accordance with the provisions of Section 1.16 of this Specification and the relevant Australian Standards.

4.4 EMBANKMENTS

Placing of filling on the prepared areas shall not commence until the fill has been approved by Council in accordance with Section 1.5 of this Specification.

Embankments shall be constructed of the approved material in accordance with Sections 4.2 and 4.3 of this Specification and shall be carried up in horizontal layers extending across the embankment of not greater than 250 mm in thickness, loose measurement, and each layer shall be compacted in accordance with the provisions of Section 4.5 of this Specification.

Rocky material not exceeding 150 mm maximum dimension may be used in embankments. Such material shall be well distributed throughout the embankment to the satisfaction of Council's Engineer. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact embankment.

Logs shall not be placed near the toe of embankments to act as retaining walls. Rock may be used for this purpose by the Supervisor provided such rocks are embedded a minimum of 300 mm below the natural surface at the lowest point and provided it is done in a neat and tidy manner.

Where the cross slope of the natural surface is steeper than 1(V):3(H), the base of the entire embankment shall be suitably stepped, scarified or roughened to the satisfaction of Council's Engineer before construction of the embankment is commenced. Natural ground adjoining an existing embankment together with the existing batter shall be similarly treated before widening.

4.5 BOXING OUT

The formation of roads, accessways, parking areas and concrete paths shall be boxed out for the construction of the pavement as shown on the Engineering Plans.

Boxing in cuttings shall be formed by excavation from the solid. Boxing in embankments may be formed by building up and compacting by rolling the footway and then trimming the inside edges vertically to correct line.

At locations of unfilled boxing where by reason of the centreline grading water would tend to accumulate, the Supervisor shall make temporary provision for drainage and diversion of the water. Care must be taken to guard against scour of any part of the construction, and should any damage result the Supervisor shall make good. Cuts for temporary drainage shall be restored before the pavement materials are placed, unless retained for use as catch or shoulder drains.

4.6 COMPACTION OF EARTHWORKS AND SUB-GRADES

The compaction and testing of earthworks and sub-grades shall be undertaken in accordance with Section 3.6 of this Specification.

The sub-grade profile shall be tested by template to ensure accuracy, and any irregularities shall be made good by the addition or the removal of material, followed by further rolling. All soft or unstable patches and any laminating layers which may develop during compaction shall be removed, refilled with approved material and rolled until thoroughly compacted and blended with adjacent materials.

In addition, the Supervisor will be required to provide a three (3) wheeled self propelled roller for testing of the sub-grade and subsequent pavement layers. This roller shall have rear rolls of minimum 1200 mm diameter and an intensity of loading 7000 kg per metre width of roll, unless otherwise approved by Council.

Council shall direct which sections of sub-grade are to be proof rolled. Compaction shall continue until there is no visible movement of the sub-grade under the proof roller and the specified dry density ratio has been achieved. No further layers may be compacted until subsequent layers have been proof rolled and the results of the compaction tests approved by Council's Engineer.

After compaction the finished sub-grade shall be at not less than the specified depth below grade line and for the required widths. Shoulders, medians and footways shall be true to profile.

4.7 BATTERS

The sides of cuttings and embankments, unless Council directs otherwise or unless detailed differently in the Engineering Plans, shall be trimmed to batters having a ratio in accordance with Section 2.4.8 of Council's Design Specification. Cuttings and embankments shall be shaped as specified in Section 4.4 of this Specification. Council may direct that any overhanging, loose or unstable material, whether outside or behind the specified slope, be removed.

SECTION 5 - STORMWATER DRAINAGE

5.1 DESCRIPTION

This Specification outlines the requirements for the excavation and backfilling of trenches and the supply, bedding, laying and jointing of reinforced concrete, fibre cement, vitrified clay and UPVC pipe drainage lines, and the construction of precast reinforced concrete box culverts.

Where indicated on the Engineering Plans, the Supervisor shall construct culverts and pipelines complete with connections to the required headwalls and/or pits. All work shall be in accordance with the details shown on the Engineering Plans and the provisions of this Specification.

5.2 DRAINAGE LINE LOCATION

The location of each drainage line shall be determined from the details of the Engineering Plans, standard drainage structure drawings, longitudinal profiles of drainage lines and ancillary special drawings.

Drainage lines shall be constructed so that their centreline coincides with the centreline of the respective internal wall of the specified standard drainage structure or as detailed on the Engineering Plans. Where possible skewed side entry pipes shall be constructed so that the prolongation of their centreline coincides with the centreline of the outlet pipe at the downstream internal face. Please discuss with the Principal Certifying Authority where multiple inlets or multiple outlets occur.

Drainage lines within proposed drainage easements shall be centrally located and no segment of a pipe, culvert or drainage structure shall be constructed outside the easement boundaries.

Should trees exist along the proposed drainage line, or so close to the trench that damage to trees would be unavoidable, then no work is to occur without first obtaining development consent to remove or trim trees.

5.3 MATERIALS

All pipes, Precast Reinforced Box Culverts must be manufactured in accordance with the relevant Australian Standards, by a supplier who undertakes Quality Assurance inspection and testing. It is the responsibility of the Supervisor to ensure that batch testing results are provided to the Council Engineer prior to incorporation into the Works. Similarly, the Supervisor must provide written evidence to the Council Engineer, of inspection after delivery certifying that the pipes or Reinforced Concrete Box Culverts are not damaged prior to incorporation into the Works. Where defective materials are shown to occur, the defective materials must be removed at the developers cost.

5.3.1 Reinforced Concrete Pipes

Where indicated on the Engineering Plans, Reinforced Concrete Pipes shall be provided. Unless otherwise specified on the Plans, the pipes shall be precast reinforced concrete, Class 2, and shall be of the spigot and socket, rubber ring jointed type. Bedding type shall be HS# unless otherwise noted.

Fibre Reinforced Pipe may be used, where it complies with AS 4139 2003 – Fibre Reinforced Concrete Pipes and Fittings.

Pipes and specials such as bends and off-takes shall conform to AS 4139 “Fibre Reinforced Concrete Pipes and Fittings and AS 3725 ‘Loads on Buried Concrete Pipes’ as applicable. Council reserves the right at any time to call for any or all of the tests specified in AS 4139 in relation to Load,

Hydrostatic Pressure and Absorption to be carried out on each pipe size and consignment prior to the pipes being used in the work.

Any pipe or pipes may be selected for the above tests and if any pipes do not comply with the test requirements these shall be replaced with satisfactory pipes by the Supervisor, at the developer's expense.

5.3.2 UPVC Pipes

In locations other than trafficable areas and public road reserve, the use of UPVC pipe Class SH with a nominal diameter of between 100 mm and 300 mm shall be permitted in lieu of other pipes of similar size. Pipes and fittings shall conform to the requirements of AS/NZS1260 'UPVC Pipes and Fittings for Drain, Waste and Vent Application' and shall be rubber ring jointed.

Stored pipes shall always be protected from direct sunlight by stacking in the shade or under cover. Joints shall be glued with recommended adhesive in accordance with manufacturer's recommendations.

5.3.3 Precast Reinforced Concrete Box Culverts

Where shown on the Engineering Plans, Precast Concrete Box Culverts shall be provided and shall be erected on cast-in-situ bases.

Precast Concrete Box Culverts shall conform to the requirements, including load tests and water absorption tests, of AS4058 'Precast Concrete Pipes (Pressure and Non-pressure)'. Council reserves the right at any time to require testing in accordance with this Specification at the developer's expense.

If required by the Council, the Supervisor shall provide documentary evidence that the intended box culverts comply with all aspects of AS1597 'Precast Reinforced Concrete Box Culverts'.

5.3.4 Mortar

Unless otherwise shown on Engineering Plans or specified, all mortar used shall be composed of one (1) part of cement to three (3) parts of sand. The sand shall be clean and free from any organic or foreign matter and, if necessary, it shall be washed to conform to these requirements. Up to 10% of lime shall be added if approved by the Principal Certifying Authority.

The sand and cement shall be gauged by measurement, thoroughly mixed, first in a dry state and afterwards with clean fresh water until well incorporated. The mortar shall be mixed on clean sawn timber platforms or in a mechanical mixer close to where it is required. The mortar shall be used fresh; any which has become hard or partially set shall be at once removed from the work.

Where pipe joints to be made may be affected by water during construction, jointing material shall comprise one (1) part cement and one (1) part of approved clay in lieu of cement mortar. Mortar joints shall be protected from the sun, and if necessary covered with earth or wet bags to prevent rapid drying of mortar for at least 3-days after placing.

5.4 TRENCH EXCAVATION

Wherever appearing in the Specification 'excavation' shall mean excavation in all classes of material.

The Supervisor shall excavate drainage line trenches to the lines and levels shown on the Engineering Plans, with allowance for bedding in accordance with Section 5.5 of this Specification.

Trenches shall be excavated to a sufficient width so that a minimum space of 150 mm is created between the side of the trench and the outside of the pipe barrel. Where necessary to allow the proper handling, jointing and placing of all types of pipes specified, additional excavation may be required.

Unless otherwise specified by Council, trench excavation for bedding on rock shall be a minimum of 200 mm below underside of pipe barrel. For bedding on foundation other than rock the trench shall be excavated over its full width to a level at least 150 mm below underside of pipe barrel before bedding material is placed. All loose material shall be removed from the bottoms of trenches prior to the placing of approved granular bedding material.

Should the Supervisor excavate trenches to depths greater than what is necessary to achieve the levels shown on the Engineering Plans, the excess excavation shall be backfilled to the correct level with approved bedding material compacted to the equivalent of 95% standard maximum dry density.

The trench bottom must be stabilised in accordance with AS3725 'Loads On Buried Concrete Pipes'. In wet or unstable ground conditions where the trench bottom requires further stabilising, additional approved bedding material, in conjunction with an approved filter fabric, shall be placed below the standard bedding as directed by the Council Engineer.

Excavation with the use of explosives shall not be permitted.

The Supervisor is liable for any accident, damage to the project or other works and properties and injury or loss arising from any cause whatsoever to persons employed by the Supervisor, by Council or otherwise. The Supervisor must ensure that certificates of currency of the relevant insurances are provided to Council prior to the commencement of any works, in accordance with Section 1.7 of this Specification, in order to protect Council from any costs associated with such damages or injuries and any compensation arising there from. The cost of all such damages or injuries any compensation arising there from shall be met by the developer.

5.4.1 Shoring and Battering

Subject to any Act of Parliament, Ordinance or Regulation, the Supervisor shall provide shoring to any excavation as required and shall accept the sole responsibility as to its being required and to its use in the works.

The execution of any additional excavation by benching or sloping of the trench walls to offset the necessity of shoring may be approved by the Principal Certifying Authority, subject to the Supervisor supplying, placing and compacting all additional specified backfill material required to make good the soil excavation in accordance with this Specification.

5.4.2 Laying in Filled Ground

Where pipes are required to be placed in filled ground, or in any case where the top of the pipe would be less than 400 mm below the natural surface, filling shall first be placed and thoroughly compacted in accordance with the provisions of Section 3.6 and Section 4.6 of this Specification to at least 400 mm above the top of the proposed pipeline. The trench shall then be excavated in the normal manner to the required levels, and after laying and jointing of pipes, the line shall be backfilled in accordance with the requirements of Section 5.11 of this Specification.

5.5 PIPE BEDDING

The material used for bedding of pipes shall be approved compacted granular material and shall conform to the grading shown in Table 5.1:

Table 5.1 Grading Requirement for Pipe Bedding Materials

SIEVE	4.75 mm	2.36 mm	1.18 mm	600µm	300µm	150µm	15µm
% PASSING	90-100	80-100	50-95	30-75	10-30	0-10	Nil

Samples of the types of materials intended to be used shall be submitted to, and approved by Council prior to their use.

Bedding material shall be placed and compacted so that the depths and types of bedding material are as shown on the standard drawings in this document and the top of the compacted bedding material is at the correct level for pipe laying in order to achieve the levels shown on the Engineering Plans.

The pipe bedding must be placed on stabilised ground in accordance with AS3725 'Loads on Buried Concrete Pipes'. Where the trench is excavated in waterlogged or unstable ground, the pipe bedding shall be made up of a layer of 40 mm to 20 mm aggregate wrapped in geotextile and laid to a depth of 300 mm below the pipe to produce a stable layer and shall extend the full width of the trench. Where in the opinion of the Principal Certifying Authority the crushed rock would not form a suitable foundation for the pipe, a concrete cradle (Type A bedding), may be used instead.

5.6 METHOD OF PIPE LAYING

All pipes shall be laid in accordance with the requirements of AS3725 'Loads on Buried Concrete Pipes'. Before pipes are laid all dirt that may have entered the pipe shall be removed and the outside of spigots and inside of sockets thoroughly cleaned of foreign matter.

The pipes shall be laid and jointed accurately to lines, gradients and levels shown on the Engineering Plans. All pipes shall be laid in such a manner that pipe barrels have solid bearing throughout their length. Reinforced concrete pipes must be laid with the lifting hole to the top. Where the pipe manufacturer indicates a specific top of pipe, this direction should be adhered to when laying the pipes.

Where shown on the Engineering Plans or where the grade of the pipeline is 15% or more, concrete bulkheads shall be provided at every second joint. Bulkheads shall be located directly behind the downstream collar so as not to encase the joint.

The maximum departure from the grade shall not exceed 8 mm between any two (2) point's 8-metres apart. Moreover no portion of the work shall depart more than 15 mm from true level, as determined from the nearest convenient bench mark.

Any pipe or pipes not laid within those tolerances shall be lifted and re-laid so that the gradient and alignment are within the tolerances specified. Such lifting and relaying or other approved corrective measures shall be at the cost of the developer if the defects occur or become apparent at any time before the expiry of the Maintenance Period.

Unless otherwise approved, pipe laying shall commence at the low points of the pipeline and proceed up the grade of the pipeline.

Where bandage joints are used, small recesses 150 mm long shall be left under pipe joints to permit jointing. Where spigot and socket pipes are specified, an appropriate length recess shall be left under pipe joints to allow the barrels to bear evenly on the bedding for their full length.

Where two (2) or more lines of pipe are to be laid side by side, the space between the lines of pipe shall be of a width of 300 mm unless otherwise specified or shown on the Engineering Plans.

Where a drainage line is to be constructed on a curve, straight pipes shall be used unless splayed pipes are specified. The linear deflection of each pipe of curved pipelines shall not exceed the manufacturer's recommendations. Thrust blocks are required at every joint of curved pipelines and

shall be installed in accordance with AS/NZS 2566 'Buried Flexible Pipelines'.

Where indicated on the Engineering Plans, pipe bends and fittings shall be installed in accordance with the provisions of Section 5.3 of this Specification and shall be laid to the details shown on the Engineering Plans.

Pit walls and floors shall be constructed as pipe laying proceeds. Walls shall be brought at least to the level of the pipe obvert during the laying of pipelines unless otherwise directed by Council. Pits poured in separate lifts shall be reinforced at construction joints. The size, frequency and length of reinforcement embedment shall be as detailed in the Engineering Plans.

Provision shall be made for the temporary drainage of any road boxing or pavement in the event of rain. The Supervisor shall ensure that this temporary drainage does not cause erosion or siltation of pipelines, nuisance to adjacent properties and the like. All temporary drainage lines are to have appropriate erosion and sediment control devices installed.

5.7 METHOD OF JOINTING

5.7.1 Rubber Ring Type

All socketed rubber ring type reinforced concrete pipes shall be jointed in accordance with the manufacturer's requirements. Care must be taken to ensure that the joint is free from dirt or other obstructions and that the rubber rings are placed evenly in the joint. In the case of fibre reinforced concrete pipes, a proprietary collar is to be applied.

All holes provided in concrete pipes for lifting or handling purposes shall be plugged by precast concrete or plastic plugs and mortar set (with no spill through into the pipes) to Council's satisfaction, before the backfilling of the trenches is commenced.

5.7.2 All Types

Where possible, the joint immediately adjacent to a pit and/or a headwall shall not be made until after the pit or headwall is constructed. In all cases care shall be taken that the interior of pipes are cleaned of any excess jointing material after jointing.

All holes provided in concrete pipes for lifting or handling purposes shall be plugged by precast concrete or plastic plugs and mortar set (with no spill through into the pipes) to Council's satisfaction, before the backfilling of the trenches is commenced.

5.8 DIRECT CONNECTIONS

Where direct pipe connections are shown on the Engineering Plans, both pipes shall be carefully cut or manufactured so that a neat junction is obtained. The inside joints shall be neatly and tightly finished off with cement mortar so that the internal shapes of the pipes are maintained.

For junction pipes factory fabricated off-takes shall be supplied in accordance with the provisions of Section 5.3 of this Specification and shall be laid to the details shown on the Engineering Plans. The Supervisor may use fabricated off-takes in lieu of jointing on site for smaller diameters. Concrete pedestals shall not be provided when factory fabricated off-takes are used.

5.9 CONCRETE ENCASING

Concrete encasement, where shown on Engineering Plans, or where directed by Council, shall have a minimum thickness of 150 mm above and below the pipe collar, and shall extend the full width of

the trench. Concrete encasement of pipelines must be constructed in a single pour with no construction joints. Pipes to be encased shall be firmly supported to design line and level.

5.10 PRECAST REINFORCED CONCRETE BOX CULVERTS

The crown units shall be positioned true to line, level and grade as shown on the Engineering Plans, and the sections closely butted together. To achieve this, the crown unit legs shall be set on a nominal 5 mm thickness of 3 to 1 wet cement mortar.

The interior of the crown units must have a neat, smooth and uniform surface at the joints. To achieve this, the sides and top of the crown units for the full length of the butt joint shall be covered with an appropriate seal to the crown units so as not to allow backfill material into the joint and to eliminate 'piping' through the joint, all to the satisfaction of Council.

The trenches at the sides of Precast Crown Units shall be carefully packed and solidly rammed with sand or metal dust in uniform layers and shall be carried up to the top of the precast section all to the satisfaction of Principal Certifying Authority.

5.11 BACKFILLING

All drainage lines shall be inspected and approved by Council prior to backfilling. Unless otherwise specified or directed, drainage excavations shall be backfilled and compacted with approved non-cohesive granular material in accordance with AS3725 'Loads on Buried Concrete Pipes' and Section 5.5 of this Specification, to sub-grade level under roads or a maximum of half the internal diameter of the pipe above the pipe invert in other areas. Selected backfilling shall be placed in layers not exceeding 300 mm compacted thicknesses.

Compaction shall continue until a dry density ratio (AS1289.5.4.1 'Dry Density Ratio, Moisture Variation and Moisture Ratio') has been achieved of not less than 100% standard under roads and 95% standard in other areas using the in-situ dry density test method given in AS1289.5.3.1 'Determination of the Field Density of a Soil - Sand Replacement Method Using a Sand-Cone Pouring Apparatus', or the laboratory compaction test method given in AS1289.5.1.1 'Determination of the Dry Density/Moisture Content Relation of a Soil Using Standard Compactive Effort'. Alternatively, the Density Index test may be used.

Compaction shall be achieved by flooding of the backfilled trench and the effective use of a 75 mm diameter concrete vibrator, or other equipment approved by Council, to expel all trapped air voids within the backfilled material. In this regard the Supervisor must construct appropriate pits to sub-grade level prior to compaction and shall take all precautions necessary to avoid possible flotation of pipelines. During subsequent pavement construction, the Supervisor must ensure that the specified granular backfill is brought to the sub-grade surface or a topping layer of the designated sub base pavement material is placed and compacted to complete the trench backfill. If sand is used as the trench backfill material, then a geofabric layer must be provided between the trench backfill and the sub base layer. No lumps or layers of clay, silt or unsuitable material are to be left in place separating the pavement material from the granular trench backfill.

Following compaction of the trench backfill, further backfilling necessary to completely refill the trench consisting of the designated pavement materials in roads and imported fill in other areas, shall be placed and compacted and the trench area shall be finally trimmed to restore the surface to final levels. Compaction of this trench backfill shall be undertaken until a dry density ratio has been achieved of not less than 100% standard under roads and 95% standard in other areas in accordance with this Section of the Specification.

Upon completion of pipe laying, jointing and backfilling of the drainage line, the whole of the drainage line including junction pits, inlet pits, etc., shall be thoroughly cleaned to the satisfaction of Council and maintained in that state for the duration of the maintenance period.

5.12 INTERALLOTMENT DRAINAGE LINES

Where indicated on the Engineering Plans or directed by Council, the Supervisor shall construct interallotment drainage lines complete with fittings, pits and connections to stormwater pits and/or pipes.

Materials shall comply with the requirements of Section 5.3 of this Specification. If reinforced concrete pipe is used, pipe joints shall be of the spigot and socket, rubber ring type unless otherwise specified on the Engineering Plans, with jointing being carried out in accordance with Section 5.7 of this Specification. PVC drainage lines may be used.

The pipes shall be laid to the lines and levels shown on the Engineering Plans or as directed by Council. Pipes shall be laid on their barrel on a minimum 50 mm of approved compacted granular bedding material provided in accordance with Section 5.5 of this Specification.

Inlet and inspection pits shall be constructed in the positions shown on the Engineering Plans and in accordance with AS3500.3 'Plumbing and Drainage'.

Connections to the stormwater drainage lines shall be provided by the construction of an inspection pit located inside the property boundary

All lines shall be inspected and approved by Council after laying and jointing and prior to backfilling. Selected material from trench excavation shall be used for backfilling unless directed otherwise by Council. Trench backfill shall be compacted to the satisfaction of Council and the trench area shall be finally trimmed to the final design levels.

5.13 SUBSOIL DRAINAGE

Subsoil drainage shall be constructed where shown on the Engineering Plans or in the positions and in the manner required by the Principal Certifying Authority.

Subsoil drainage shall be laid adjacent to every stormwater pipe and culvert for a minimum distance of 3-metres upstream of each pit. However where the subsoil drainage pipe shall be fitted with a filter sock. The filter sock shall be appropriately tied at the upstream end of the subsoil pipe to preclude the entry of filter material. The subsoil pipeline shall be laid at the same grade as the stormwater pipeline or culvert.

Where shown on the Engineering Plans or where directed by the Principal Certifying Authority, , subsoil pipes shall be laid for the full length or part thereof, along stormwater drainage lines between kerb inlet pits.

5.13.1 Materials

- (a) Pipes shall consist of minimum 100 mm diameter or as shown on the Engineering Plans;
- (b) Pipes shall be perforated corrugated or smooth wall polyethylene or UPVC pipe, Class 400, conforming to AS2439 'Perforated Plastics Drainage and Effluent Pipe and Fittings';
- (c) Class 1000 shall be used under roadworks.
- (d) Filter Socks shall be stretch or non stretch of approved manufacture. Any runs or holes in the filter sock must be repaired prior to incorporation into the Works;
- (e) Filter sock fabric woven or non woven shall be of approved manufacture and shall comply with the relevant Australian Standard requirements and the requirements of the ARRB Publication titled Sub Surface Drainage Progress Report September 1979, Section 6 'Guidelines for the Use of Engineering Fabrics for Subsoil Drainage';
- (f) Filter Material shall be approved clean granular material complying with the following;

- (i) Type 1 drain (to be used where the subsoil drain is associated with the stormwater drainage)– coarse washed sand and complying with the requirements of pipe bedding material in Section 5.5 of this Specification. Council may allow the use of a nominal size aggregate (10 mm maximum) in lieu of sand as the filter material, if the recommended design procedure shows that the aggregate is compatible with the in-situ material;
 - (ii) Type 2 drain (to be used where the subsoil drain is to be used in isolation) – nominal 10 mm aggregate; and
- (g) Inspection/cleaning eyes must be constructed as a solid UPVC pipe and be formed by a 90-degree bend to the surface with an approved cover to create a flushing point.

5.13.2 Trench Excavation in Roads

Trenches in roads shall be clean cut to a minimum width of 300 mm and a minimum depth of 600 mm as measured from the design level of the sub-grade and shall be true to line and grade.

Where circumstances require (such as to intercept seepage from electrical conduit trenches), additional depth shall be provided to collect subsoil flows.

5.13.3 Bedding, Laying and Backfilling

Pipes shall be bedded on 50 mm thickness of the specified filter material, shall have a minimum grade of not less than 1% and shall be connected to downstream stormwater drainage pits to the satisfaction of Council.

After laying the pipes the trench above and around the pipe shall be filled with the specified filter material in layers not exceeding 300 mm compacted thickness and shall be compacted as specified.

Inspection/cleaning eyes shall be incorporated at intervals not in excess of 60-metres where necessary.

5.13.4 Compaction

For sand drains compaction shall comply with the requirements of Section 5.11 of this Specification.

For aggregate drains high frequency, low amplitude vibrating plates shall be used without the addition of water. Compaction shall be carried out to the satisfaction of the Council Engineer.

5.14 TOLERANCES ON DRAINAGE STRUCTURES

5.14.1 Tolerances on Pipelines

For pipelines the tolerances in the level of the invert of the pipe shall be as follows:

- (a) Finished level of the invert at any point - minus 15 mm, plus 15 mm, provided that no point is at a higher level than a corresponding point upstream; and
- (b) Grading – minus 0.2%, plus 0.2% at any point.

5.14.2 Tolerances on Pits and Headwalls

The tolerances for pits and headwalls shall be as follows:

- (a) Finished level of inverts, soffits and upper surfaces – minus 15 mm, plus 15 mm.
- (b) Other dimensions – minus 25 mm, plus 25 mm.
- (c) Chainage of centre line of pits – 150 mm.
- (d) Deflection of exposed edges – 10 mm.
- (e) Cover to steel reinforcement – minus 5 mm, plus 10 mm

5.14.3 Tolerances on Earth Drains

The tolerances for open earth drains shall be:

- (a) Depth – minus zero (0), plus 75 mm, provided that no point is at a higher level than a corresponding point upstream; and
- (b) Width at all parts of cross section – minus zero (0), plus 300 mm.

SECTION 6 - CONCRETE STRUCTURES

6.1 DESCRIPTION

This Specification outlines the requirements for the forming, reinforcing, mixing and placing of concrete used in the construction of concrete pavements, drainage structures, kerb and gutter and other miscellaneous minor special structures, inclusive of the supply and installation of precast concrete components.

The Supervisor shall construct all the structures shown on the Engineering Plans to the details specified and in accordance with the provision of the Specifications.

6.2 CONCRETE TYPES

6.2.1 Ready Mixed Concrete

The Supervisor shall always use ready mixed concrete for the works unless supplies are not reasonably available. Ready Mixed Concrete shall be obtained from a supplier who undertakes Quality Assurance inspection and testing and shall comply with the requirements of AS1379 'Specification and Supply of Concrete'. Concrete strength requirements are provided in later sections of this document..

In the event of the failure of the agitating equipment during transport, the concrete will not be accepted.

Unless otherwise specified, the cement shall be Type A Portland cement in accordance with the requirements of AS3972 'Portland and Blended Cements' or Type FA or Type SA blended cements as defined in AS3972. The nominal maximum size of aggregate shall be 20 mm, and the mix design shall be prepared on the basis of the concrete being placed direct from the truck mixer discharge chute.

Concrete is to be placed in the form by chuting unless Council approves some other mode of delivery and placement. When chuting or pumping is the method used for placing, an approximately continuous flow shall be maintained.

The inclination of the chutes shall be such as will permit the flow of the concrete at the specified consistency without separation of the ingredients, and the chute and truck shall be moved during discharge as may be directed. The chutes shall be long enough to permit delivery to the whole of the area enclosed by the forms.

6.2.2 Concrete Other Than Ready Mixed Concrete

When suitable supplies of ready mixed concrete are not readily available the Supervisor may be permitted to mix on the site in a mechanically operated batch mixer of approved type. The capacity of the drum shall be such that only whole bags of cement are used in each batch.

When concrete is mixed on the job, it shall be composed of a minimum of one (1) part of cement, two (2) parts of fine aggregate and four (4) parts of coarse aggregate. The relative proportions of the fine and coarse aggregate may be varied subject to the approval of Council, to give a denser or alternatively a more workable mixture, but the proportion of cement to the combined volumes of fine and coarse aggregate, each measured separately, shall be sufficient to give the strength specified in Section 6.5 of this Specification.

The quantity of water added to the concrete shall be such that the consistency of the concrete (slump)

shall be as specified in Section 6.2.1 of this Specification.

The materials shall be accurately proportioned before being placed in the mixer drum and shall be placed dry in the drum in regular consecutive charges. After the materials have been placed in the mixer drum these shall be given three (3) complete turns in the dry. Water shall then be added and the whole turned for a minimum of 1.5-minutes; and until the materials have a uniform distribution throughout the mass and each portion of aggregate is coated with cement.

The entire contents shall be discharged from the drum before any materials are placed therein for the succeeding batch.

6.2.3 Hand Mixed Concrete

In the case of breakdown of mechanical mixing equipment, hand mixing in small quantities may be utilised so as to complete a section of the work or reach a construction joint, subject to the approval of Council.

Hand mixing shall be done on a water tight platform. The sand and cement shall be first mixed until a uniform colour has been obtained, and the mixture shall then be spread uniformly upon the metal or gravel and the whole of the materials shall be given two (2) complete turns in the dry. The mass shall then be turned over at least three times during which clean fresh water shall be added in such quantities as will ensure a concrete of the consistency (slump) specified in Section 6.2.1 of this Specification. Mixing shall continue until the concrete is thoroughly homogeneous and uniform in colour and consistency.

6.2.4 General

Marine grade concrete should be specified for high saline ground conditions in relation to stormwater assets.

6.3 CLEANING OF CONCRETE EQUIPMENT

Concrete mixing, placing, finishing and transporting equipment such as truck agitators, barrows, hand tools, concrete helicopters, kerb machines and moulds shall not be washed down or cleaned in any area not approved by Council.

Prior to commencing any concrete works, the Supervisor must nominate an area within the site for such clean up to occur. Said site must be approved by Council and must comply with all aspects of Section 11 of this Specification.

6.4 CONCRETE MATERIALS

6.4.1 Cement

All cement used shall be Portland cement of approved brand, Australian manufacture, and certified by an Australian State or Commonwealth Government Testing representative as complying with the requirements of AS3972 "Portland and Blended Cements". The cement shall be Type A Portland Cement unless otherwise specified.

If required by Council, documentary or other acceptable evidence of the quality of the cement shall be furnished by the Supervisor.

Cement which has been stored for a period in excess of three (3) months from the date of testing shall not be used in the Works.

6.4.2 Fine Aggregate

Fine aggregate shall consist of clean, hard, tough, durable uncoated grains, uniform in quality, and shall conform to the requirements of AS2758 'Aggregates and Rock for Engineering Purposes'.

Fine aggregate shall be evenly graded within the limits shown in Table 6.1:

Table 6.1 Grading of Fine Aggregates

AUSTRALIAN STANDARD SIEVE	QUANTITY PASSING PERCENT BY WEIGHT (NATURAL FINE AGGREGATE)	QUANTITY PASSING PERCENT BY WEIGHT (CRUSHED FINE AGGREGATE)
9.5 mm	100	100
4.75 mm	90-100	90-100
2.36 mm	60-100	60-100
1.18 mm	30-100	30-80
600µm	15-100	15-60
300µm	5-50	5-40
150µm	0-15	0-25
75µm	0-5	0-10

6.4.3 Coarse Aggregate

The coarse aggregate shall be clean, hard, durable crushed stone, or crushed river gravel, and shall conform to the requirements of AS2758.1 'Concrete Aggregates' relating to the presence of harmful materials.

The resistance to abrasion shall be determined as set out in AS2758.1 'Concrete Aggregates' and shall not exceed a Los Angeles value of 35.

The coarse aggregate shall comply with the requirements of AS2758.1 'Concrete Aggregates' relating to Soundness and Particle Shape.

Coarse aggregate based on a nominal size of 20 mm, shall be evenly graded or combined to comply with the grading requirements shown in Table 6.2:

Table 6.2 Grading of Coarse Aggregates

AUSTRALIAN STANDARD SIEVE	QUANTITY PASSING PERCENT BY WEIGHT
26.5 mm	100
19.0 mm	90-100
9.5 mm	25-55
4.75 mm	0-10
2.36 mm	0-5
75µm	0-2

6.4.4 Water

The water used for the work shall be drawn from an approved source, and shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials, and other deleterious substances.

6.4.5 Additives

Special additives or combinations of additives may be used only if approved by the Principal Certifying Authority.

6.5 CONCRETE TESTING AND STRENGTH

Unless otherwise specified by the Principal Certifying Authority the concrete shall develop a minimum 28-day crushing strength in accordance with Table 6.3 when sampled and tested in accordance with the requirements of this Specification:

Table 6.3 Minimum Crushing Strength of Concrete

ITEM OF WORK ⁽¹⁾	MINIMUM CRUSHING STRENGTH AT 28 DAYS ⁽¹⁾
Bus bays	32 MPa
Private access roads and community title roads	32 MPa
Footway, dish crossing and aprons	20 MPa
Drainage pits, headwalls, channel linings	20 MPa
Kerb and gutters	20 MPa
Concrete pathways	20 MPa
Structural headwalls and special structures	As specified in the Engineering Plans

(1) The minimum 7-day crushing strength must be 50% of the 28-day crushing strength.

The strength of concrete shall be assessed on the results of the 28-day tests, although it may be accepted without further testing if the 7-day tests are satisfactory, subject to the approval of the Principal Certifying Authority. It is the Supervisors responsibility to ensure that the 7-day and 28-day test results are submitted to the Principal Certifying Authority prior to issue of the Subdivision Certificate.

The strength specified at 28-days shall be increased for tests at ages in excess of 28-days in accordance with Table 6.4:

Table 6.4 Increase in Minimum Crushing Strength of Concrete

AGE OF TEST SPECIMEN IN DAYS ⁽¹⁾	FACTOR
28	1.00
56	1.08
84	1.12
224	1.22
365 and greater	1.25

(1) For intermediate ages, the factor shall be determined on a pro rata basis.

6.5.1 Sampling of Concrete

Sampling and testing requirements shall be in accordance with this Specification and as directed by Council. The test specimens shall be 300 mm by 150 mm diameter cylinders, prepared by the Supervisor, from samples taken in accordance with AS1379.7 'Specification and Supply of Concrete – Inspection, Sampling and Testing' and AS1012.8 'Making and Curing Concrete Compression, Indirect Tensile and Flexure Test Specimens in the Laboratory or in the Field'.

Compressive strength samples shall be taken, distributed as evenly as possible, over the number of truckloads being delivered.

For each sample at least two (2) cylinders shall be cast for testing. A pair of test specimens shall be moulded from each twenty cubic metres of concrete. Additional samples may be taken at the discretion of Council. The test strength of the sample shall be the average of the strengths of the two (2) or more specimens.

Alternatively, in lieu of moulding cylindrical test specimens Council may arrange for cores to be extracted from the structure in accordance with AS1012.14 'Securing and Testing Cores from Hardened Concrete for Compressive Strength or Indirect Tensile Strength'. All core holes left as a result of coring requested by Council shall be filled with 20 MPa concrete to the level of the surrounding material. Core sampling shall not be undertaken unless approved by Council.

Generally, the test core taken from concrete delivered on a particular day shall be considered to represent the whole of the concrete poured on that day. The Principal Certifying Authority may agree to additional core testing before rejecting poured concrete.

6.5.2 Testing of Concrete

The moulded specimens of concrete taken at the time and place of delivery in accordance with AS1012.9 'Determination of the Compressive Strength of Concrete Specimens' and the cores extracted from the structure in accordance with AS1012.14 'Securing and Testing Cores from Hardened Concrete for Compression Strength or Indirect Tensile Strength' shall be tested by a NATA registered laboratory.

If the average strength of cores taken from concrete delivered on a particular day complies with the specified requirements, the concrete will be accepted. If strength varies from that specified, Council may refuse to accept the structure constructed from that concrete and such shall be reconstructed with concrete of strength as specified. A 10% variation may be adopted as acceptance/rejection criteria.

It is the Supervisors responsibility to ensure that the 7-day and 28-day NATA certified test results are submitted to Council for approval.

6.6 FOUNDATIONS

Foundations shall be excavated to the levels and dimensions shown on the Engineering Plans, or as directed by Council in accordance with Section 4 of this Specification.

All soft, loose, yielding or other unsuitable materials shall be removed and replaced with approved materials. The bottoms shall be dressed to a smooth and regular surface and thoroughly compacted to give the foundation of uniform bearing value throughout.

No concrete shall be placed until the foundations have been inspected and approved by Council.

6.7 REINFORCEMENT

Reinforcing bars shall be of mild steel conforming to AS1302 'Steel Reinforcing Bars for Concrete', AS1303 'Steel Reinforcing Wire for Concrete', AS1304 'Welded Wire Reinforcing Fabric for Concrete' and AS/NZS4671 'Steel Reinforcing Materials'.

Other forms of reinforcement may be permitted subject to the Supervisor written application and to Council's conditions of approval.

All reinforcing bars, wire and mesh shall be supplied by an Australian Certification Authority for Steel Reinforcing (ACRS) accredited supplier and shall be appropriately marked with the suppliers unique identification mark. Any reinforcing steel not so marked and supplied by an accredited ACRS supplier shall be immediately removed from the site.

All steel reinforcement shall be free from grease, tar, paint, oil, mud, mortar, or other foreign substance, and shall be true to size. If in the opinion of the Council the steel has more than a thin film of rust it may be rejected for use in the work and shall be immediately removed from the site. Supervisor

All the reinforcement shall be spaced accurately to the pitches and positions shown on the Engineering Plans and bent and hooked cold at the points shown. Reinforcement shall be secured against displacement due to the flow and working of the concrete, and shall be tied with suitable wire at all crossings of bars.

Reinforcement for slabs and similar flat surfaces shall be supported on chairs of appropriate height and made of plastic, or steel with plastic covered shields on lower ends. The use of concrete blocks, brickbats, etc, for support of steel, will not be permitted, with the exception of sewer construction.

6.8 FORMWORK

Formwork shall be built true to line and in a substantial and unyielding manner to maintain position and shape under constant force. Forms shall be mortar tight and timber forms shall be thoroughly soaked with water. Formwork for re-entrant angles shall be chamfered, and for corners shall be filleted, the bevel in each case having a width as shown on Engineering Plans, or if not so shown, of 25 mm on each side, with equal angles in all cases. Formworks in place will be subject to check and correction of line, level, and grade at any time.

Formwork shall be so designed and constructed that they may be removed without injuring the concrete. The materials to be used in the formwork shall be approved timber, free from loose knots and other defects, board or metal, in which all bolt and rivet heads are countersunk.

Timber formwork and exposed surfaces shall be dressed on one face, and the two edges shall be either dressed or tongued and grooved. For the unexposed surfaces of walls, slabs etc, timber need not be dressed.

The interior surface of the forms shall be oiled, greased, or soaped to ensure the non adhesion of the mortar. Oils, greases and soaps used on formwork against surfaces to be exposed shall not stain or discolour the concrete surface. It shall be uniformly spread in a thin film and any surplus must be removed prior to placing concrete. All formwork shall be oiled, etc, in advance of placing reinforcement to ensure that oil, etc, will not soil surfaces or reinforcement.

Any bolts supporting the formwork shall be so greased and arranged that these may be removed from the concrete after removal of forms without excessive jarring or hammering and without injury to surface of concrete spalling or otherwise. The wires passing through concrete shall be cut back, after removal of the formwork, with sharp chisels or cutters. All cavities cause by removal of bolts or tie wires shall be wetted and carefully packed with cement mortar of the same mix as that used for the body of the work and brought to an even surface with a wooden float immediately after removal of forms.

The formwork shall be inspected immediately before the placing of the concrete and any bulging or

warping shall be remedied. If at any point of the work, after the concrete has been placed, the forms show any signs of bulging or sagging, that portion of the concrete shall be immediately removed and the formwork reconstructed rigidly.

When concrete is placed in earth excavation, forms shall be provided for all vertical surfaces unless otherwise shown on the Engineering Plans or ordered by Council.

No concrete shall be placed until the formwork with reinforcement bars, wires and mesh in place has been passed by Council.

Structural certification is required for formwork greater than 3m high and also for formwork used for soffits slabs.

6.9 CONCRETE PLACING

Sub-grade, formwork and reinforcement shall be approved by Council prior to placing the concrete. Before depositing concrete, all sawdust, shavings and other debris including any temporary wooden blocks shall be removed from the space to be occupied by the concrete. Reinforcement shall be thoroughly secured in position and approved by Council.

Concrete shall be placed in the formwork by a chute in a uniform continuous flow. The length and inclination of the chute shall be such as to prevent separation of the concrete ingredients. Concrete shall not be dropped into place from a greater height than 1.5-metres. Prior to placing, the full area to be occupied by the concrete shall be thoroughly moistened with water.

Concrete shall be deposited in horizontal layers and shall be compacted by vibration, tamping, spading, and slicing. Care shall be taken to fill every part of the forms, to work the coarse aggregate back from the face, and to force the concrete under and around the reinforcement without displacing the latter.

Where tamping etc is difficult, the concrete shall be assisted into place by tapping or hammering the forms opposite the freshly deposited concrete.

Discharge of the concrete shall be completed within 1.5-hours or before the drum has revolved 300-revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates, or the introduction of the cement to the aggregates. No concrete shall be mixed or placed while the air temperature is, or is likely to be (in the opinion of Council) within 24-hours, below 4°C or while the shade temperature exceeds 38°C, without the approval of Council.

6.10 CONSTRUCTION JOINTS

Construction joints shall be provided as shown on the Engineering Plans or where it is necessary to provide a joint between separate concrete pours.

In a slab, the construction joint shall be formed with a key joint and dowels in a manner approved by Council, or on vertical sections, by finishing to a straight line with a roughened surface.

Prior to the resumption of work, the concrete surface shall be roughened, care being taken not to disturb any reinforcement or damage adjoining concrete faces. The surface shall be cleaned of all laitance, loose or foreign matter and saturated with water. The fresh concrete shall then be carefully worked against the surface of the concrete previously laid and around reinforcement bars.

6.11 REMOVAL OF FORMS

All forms shall remain in position until their removal is authorised by Council, but not less than 24-

hours after concrete has been placed, unless otherwise specified by Council.

Should the air shade temperature fall below 10°C or rise above 27°C, the minimum period may be extended by Council.

Curing of concrete shall commence immediately once forms are removed.

6.12 CONCRETE FINISHING

All concrete surfaces shall be true and even, free from air and stone pockets, depressions, or projections beyond the surface. All arises shall be perfectly sharp and true, and moulding evenly mitred. Care shall be exercised in removing forms to ensure this result. As soon as the forms are removed, all rough places, holes and porous spots shall be repaired by removing the defective work and filling with stiff cement mortar having same proportions of cement and sand as used in the concrete and brought to an even surface with a wooden float.

Bolts and tie wires protruding from the concrete after removal of the formwork shall be cut back as previously specified.

If requested, the whole exposed surface shall then be rubbed with a wooden float, or an approved carborundum or sandstone block and clean water until all rough marks or joints in forms are removed, leaving the surface clean, smooth, and uniform in colour and appearance. This work shall be completed within 2-days of removing formwork. Plastering will not be permitted.

Inlet and/or outlet pipes of structures shall be neatly finished as shown on the Engineering Plans.

Concrete wearing surfaces, after thorough compaction, shall be screeded off by an approved template. Immediately following compaction and screeding the concrete surface shall be tested for irregularities and corrections made. The surface shall be finished true and uniform, free from any glazed or trowelled finish and shall be finally dressed.

It is the Supervisor's responsibility to ensure that all concrete surfaces are free from graffiti (scratching of names etc) when handed over to Council. Anti-graffiti coatings are to be applied to all concrete surfaces to be dedicated to Council. All costs associated with the removal of such graffiti prior to the handover to Council shall be borne by the developer.

6.13 CURING

After the completion of concreting of any structure or section thereof, the completed concrete shall be protected from extremes of temperature for a period of 7-days, during which time the material shall be kept continuously moist and covered with canvas, plastic or Hessian sheets, chemical curing compounds with fugitive dyes or sand at least 50 mm thick or other approved means.

The new work shall be adequately protected from damage by weather conditions, traffic or other causes and any necessary barriers and signs for the control of traffic shall be erected and maintained for the required period.

6.14 CONCRETE ROAD PAVEMENTS

The concrete for road pavements, including strength, sampling and reinforcement where specified, shall be in all respects in accordance with the requirements of Sections 6.1 to Section 6.13 inclusive, of this Specification, except where a variation in those requirements are specified in the following sub sections.

Concrete pavements layers are generally to be constructed in accordance with the formal pavement design shown on the Engineering Plans and as prepared by a suitable qualified Structural or Civil

Engineer.

6.14.1 Base

The base course for roads with anticipated turning movements including thresholds shall be constructed in accordance with RTA Specification R83 'Jointed Concrete Base' and the Cement, Concrete and Aggregates, Australia, 'Concrete Pavement Design for Residential Streets' neglecting the thickness of the pavers. To the extent that there is any inconsistency, the RTA specification shall prevail. A minimum 100 mm thick base course of the type shown on the Engineering Plans is required under concrete pavements for factory units, commercial developments and roadways. The sub base shall comply with the Section 7.4 of this Specification.

Immediately prior to the placing of the concrete, the material forming the base shall be moistened with water, and in the case of sand, thoroughly compacted. The surface shall be checked for uniformity and all irregularities made good. Council may direct that the base be sprinkled or thoroughly wet down from 12-hours to 36-hours in advance of placing concrete, where such procedure may be deemed to be necessary, but there shall be no pools of standing water.

The surface level of the base shall be such that the concrete pavement thickness is within plus 10 mm and minus zero (0) mm of that specified on the Engineering Plans.

6.14.2 Formwork

Formwork shall comply with Section 6.8 of this Specification. Formwork provided shall be constructed to resist the pressure of the concrete and the impact of any tamping required.

Wooden forms shall be held in place by stakes driven into the ground along the outside edge at intervals of not more than 1.2-metres, two (2) stakes being placed at each joint. Stakes shall be driven at least 300 mm into the ground or further if required and shall extend to within 20 mm of top of forms. The forms shall be firmly nailed to the side stakes. Instead of wood stakes, iron pins 500 mm long and 20 mm diameter, or an approved flat iron may be used, provided they are connected to the forms by passing through holes in iron brackets or other approved means. Spikes shall be driven to 20 mm below top of forms spaces at not more than 1.2-metre centres. Steel forms shall be staked to the sub-grade by vertical steel pins passing through suitable brackets rigidly attached to the outside of the forms. These pins shall be spaced not more than 1.2-metres apart and shall be driven at least 300 mm into the sub-grade.

6.14.3 Reinforcement

Reinforcement shall be as shown on the Engineering Plans and fixing shall comply with the requirements of Section 6.7 of this Specification. All dowels and reinforcement shall be accurately placed and rigidly held in position before concrete is deposited.

Dowel bars across joints shall be of the size, spacing and position shown on the Engineering Plans, and shall extend equally on either side of joints. The dowel bars across transverse expansion joints only shall be dipped in hot bitumen Class 50 along one half of their length (all dipped ends being on the same side of joint) and sheathed with standard dowel caps in accordance with the Engineering Plans to prevent bonding with the concrete and to provide end clearance. Any caps that may become damaged from any cause shall be replaced with new caps by the Supervisor.

Edge bars surrounding each slab and around all breaks in pavement, shall be of the size, form, spacing and position shown on the Engineering Plans. Edge bars shall be lapped not less than 400 mm and securely wired at splices.

Edge bars shall either be securely staked in the correct final position prior to deposition of concrete or

they may be attached in an approved manner to the fabricated sheets of reinforcement and whole laid on the chairs on the completed base in the correct position, which shall be carefully checked as the deposition of concrete proceeds.

Mesh reinforcements shall be lapped not less than 300 mm and securely wired at splices. Where the required width or length of the mesh is not an integral multiple of the specified spacing of the bars, the width of the mesh shall be measured from tip to tip of the overhanging bars, provided extra bars are incorporated, if necessary, to restrict such overhang to not more than 75 mm.

Mesh reinforcement shall be placed and supported with a minimum 35 mm top cover for vehicular pavements and 25 mm top cover for path paving and shall be parallel to the finished upper surface of the concrete slab unless otherwise specifically called for on the Engineering Plans.

6.14.4 Placing Concrete

The placement of concrete shall be as shown on the Engineering Plans and shall comply with the requirements of Section 6.9 of this Specification.

The mixed concrete shall be deposited rapidly on the base to the required depth and entire width between forms in successive batches, and in a continuous operation, with the use of intermediate forms or rigid bulk heads between joints. The concrete shall be especially well spaded against forms, bulkheads, kerbs, gutters and other fixed surfaces. Raking or using vibrators will not be permitted in spreading concrete.

6.14.5 Joints

The jointing of concrete pavements in public and private roads shall be as shown on the Engineering Plans and shall comply with the requirements of Section 6.10 of this Specification. Joints shall be carefully constructed so that expansion and contraction may take place.

Transverse contraction joints shall be located as shown on Engineering Plans or at a maximum of 6-metre centres. Additional transverse construction joints are to be provided at a point directed by Council, to close the section whenever the placing of concrete is to be suspended for more than 30-minutes. The joint shall be square to surface and to centreline.

Expansion joints shall be located as shown on Engineering Plans or at 30-metre maximum centres. Unless otherwise specified in the formal pavement design expansion joints shall consist of bitumen impregnated jointing material or equivalent.

6.14.6 Finishing

The finishing of concrete shall be as shown on the Engineering Plans and shall comply with the requirements of Section 6.12 of this Specification.

After placing, the surface of the concrete shall be screeded off with an approved screed supported on the formwork each side or by other approved means. Immediately following screeding the concrete shall be tested for high or low spots and any necessary corrections made. The surface shall then be finished true and uniform and free from any glazed or trowelled finish and shall be at right angles to the centreline to give a uniform non slip surface unless Council directs some other form of finish such as grooving. The departures from design levels shall not exceed 5 mm. Other decorative finishes shall be in accordance with the Engineering Plans or as elsewhere specified.

Any rough places, holes or porous spots shall be repaired by removing defective work and filling with stiff cement mortar having the same proportions of cement and sand as used in the concrete and brought to an even surface with a wooden float followed by light brooming.

All exposed arises shall be neatly rounded to a 5 mm radius with a steel edging tool.

6.14.7 Sealing of Joints

Before the pavement is opened to traffic, the joint filler in all joints and around gullies and manholes and along kerbs shall be trimmed off by approved means to a uniform depth of maximum 3 mm below the surface of the pavement, and the joint swept clean of all dust, dirt and other foreign matter.

During the maintenance period all joints shall be resealed as required. Any cracks occurring shall be repaired prior to sealing.

6.14.8 Tolerances

Concrete pavements are to be constructed to the thickness shown on the Engineering Plans.

Where the thickness of the concrete slab is less than the thickness shown on the Engineering Plans by 10 mm or more, the pavement deficient in thickness shall be removed and replaced with pavement of the correct thickness in accordance with the specification at the developer's expense. A 5m survey grid on the sub-base and finished concrete base shall be used to determine actual concrete thickness.

The thickness of the slab constructed in replacement will also be tested if required by Council.

6.14.9 Backfilling

After the concrete has set sufficiently, but not sooner than 3-days and within 14-days after placing, the formwork shall be removed and the spaces adjacent to the pavement and kerbing shall be refilled with impervious material or other material approved by Council, which shall be thoroughly compacted in layers not greater than 150 mm in thickness, without displacement of the adjacent construction and the whole left in a neat and workmanlike manner.

Following the construction, curing and backfilling of the concrete the Supervisor shall immediately complete the formation, compaction and trimming of the adjacent areas to the final levels and profiles.

6.14.10 Replacement of Incorrect and/or Damaged Construction

The Supervisor shall so construct all work in an efficient and workmanlike manner so that it will resist damage and/or displacement by weather conditions, road construction, builders or other traffic and/or Service Authorities plant, or undermining by the scouring away of the base materials.

Where pavement or kerbing is damaged and/or displaced by such agencies after construction, due to fault by the Supervisor, or is not constructed to specified line and level, it shall be removed and reconstructed by the Supervisor, at the developers expense when so directed by Council.

6.15 KERB AND GUTTER

The concrete for kerb and gutters, including strength, sampling and reinforcement where specified, shall be in all respects in accordance with the requirements of Sections 6.1 to Section 6.13 inclusive, of this Specification, except where a variation in those requirements are specified in the following sections. The dimensions and design of the kerb and gutter shall be in accordance with Standard Drawing No.SD02.

6.15.1 Base

The base course for kerbs and gutters shall be formed at the required depth, the dimensions and design shown on the Engineering Plans. All base courses shall be thoroughly compacted to the requirements of Section 4.6 and Section 7.12 of this Specification and finished to a firm smooth surface of uniform bearing value.

The Supervisor shall ensure that the base materials are protected from stormwater scour prior to backfilling and/or placing of pavement materials and for that purpose shall place windrows of spoil and/or cut drains to divert stormwater runoff.

Where total pavement thickness is 200 mm or more, the base for kerb and gutter, vehicular crossings, perambulator ramps, mountable kerbs or other structures shall be prepared by extending the adjoining road pavement base course to a point at least 150 mm beyond the rear face of such kerb or other structure, all to comply with the Section 7 of this Specification in respect of both material and compaction.

Where the total pavement thickness is less than 200 mm, the base and/or sub-grade shall be formed at the required depth, in accordance with the dimensions and design shown on the Engineering Plans.

Prior to the placement of kerb and gutter the Supervisor shall make available an approved three (3) wheeled self propelled roller, for proof loading. Concrete shall not be placed until Council has approved the base.

Immediately prior to the pouring of the concrete the sub base surface shall be moistened, checked for uniformity and all irregularities made good. No concrete shall be placed until this has been done.

6.15.2 Kerb Moulding Machines

Unless otherwise specified self propelled kerb moulding machines shall be used by the Supervisor for the construction of kerb and/or gutter and subsidiary works provided and the profiles shall in all respects with the requirements of the Engineering Plans, Standard Drawings and of this Specification.

Kerb and gutters formed using a self propelled kerb moulding machines shall be in accordance with AS2876 'Concrete Kerbs and Channels (Gutters) - Manually or Machine Placed'

6.15.3 Joints

Kerb and gutter shall have vertical contraction joints provided at a maximum interval of 3-metre. When self propelled kerb moulding machines are used, the vertical expansion joint shall be formed by means of a guillotine punched completely through the kerb and gutter at right angles to the surface of both gutter and kerb face. Joints shall be neatly finished with a grooving tool exactly over the guillotine cut.

Vertical expansion joints shall be provided at the junction of kerb and gutter with mass concrete work, drainage pits, concrete crossings, etc. The joint shall be filled with a strip of granulated cork or fibre, or granulated cork matrix and bitumen, 10 mm thick, containing not less than 15% nor more than 25% of stabilizing material and having felt boards impregnated with bitumen on either side. The spacing of vertical expansion joints shall be not greater than 6-metres.

At the finish of each days work, the Supervisor shall provide a vertical expansion joint in kerb and/or gutter. This shall be done in accordance with Section 6.9 of this Specification.

6.15.4 Vehicular Crossings and Perambulator Ramps

Vehicular crossings and lipless perambulator ramps, where shown on the Engineering Plans, shall be provided in conjunction and concurrently with the construction of all types of kerb and gutters

Kerb ramps shall be constructed where shown on the Engineering Plans or where directed, to the details shown on Standard Drawing No. SD03. Contraction joints in machine moulded kerb and gutter or expansion joints in hand constructed kerb and gutter shall be provided at each end of each crossing.

The vehicular crossings shall be constructed as shown on the Engineering Plans or as otherwise specified. Vehicular footway crossings are generally to be constructed at the time of the Roads Act approval.

Vehicular accesses shall be constructed in positions shown on the Engineering Plans or as otherwise specified.

In Rural or Urban areas adjacent to roads without kerb and gutter, a dish drain or a piped access crossing shall be constructed.

6.15.5 Provision for Drainage

Outlets through the kerb shall be provided for each house to drain roof water into the gutter in accordance with the following:

- (a) For all type kerbs, a 150 mm by 50 mm Galvanised steel box section must be provided.

One (1) drainage outlet shall be provided 0.5 to 1.0-metre from the lower side of each lot boundary or from the upper end of the vehicular entrance where provided. The invert of the drainage outlet must be located at a level no greater than 10 mm above the invert of the gutter.

The Supervisor shall fit the outlets into the kerb in a workmanlike manner and ensure that they are firmly secured in the concrete, fall towards the gutter and the surface refinished to match the balance of the work. Where kerb moulding machines are used, the outlets shall be placed in position immediately after moulding.

Outlets shall be of approved manufacture and made of plate metal coated with hot dipped galvanizing in accordance with AS/NZS4680 'Hot Dipped Galvanized Coatings on Ferrous Articles'. The shape and size of the outlets shall conform to that shown on Standard Drawing No.SD26.

6.15.6 Finishing Concrete

Finishing of concrete shall comply generally with Section 6.11 of this Specification. The surface of kerb and/or gutter shall be finished clean and smooth while green by means of a steel trowel until all rough marks are removed.

6.15.7 Tolerances

Where the grade of the kerb and gutter is greater than 1% the tolerances on the level of the kerb, gutter and associated vehicle crossings shall be as set out in Section 9.16 of this Specification.

Where the grade of the kerb and gutter is less than 1% the tolerances on the level of the kerb, gutter and associated vehicle crossings shall be within plus and minus 10 mm of the design levels as shown on the Engineering Plans.

In both cases, variations in level shall not be local and shall be over a length of 15-metres or more.

The tolerances on the horizontal shall be as follows:

- (a) Lateral position – 15 mm in 15-metres provided that the variations are not local or unsightly;
- (b) 150 mm horizontal tolerances on the chainage of vehicle crossings; and
- (c) 25 mm horizontal tolerances on the dimensions of vehicle crossings.

In the event of the tolerances being exceeded, Council may order the Supervisor to carry out any reconstruction or remedial measures considered to be necessary or desirable.

6.15.8 Backfilling

No sooner than twenty four (24) hours after pouring the spaces behind the kerb and/or gutter shall be refilled with approved material. Within 14-days but not sooner than 7-days after pouring, the backfill material shall be thoroughly compacted in layers not exceeding 150 mm, without displacement of the adjacent construction and the whole left in a neat and workmanlike manner. Backfilling and/or the placement of pavement material shall only be undertaken with prior approval of Council.

Following the construction, curing and backfilling of the concrete kerb and/or gutter, the Supervisor shall immediately complete the formation, compaction and trimming of the adjacent footways to the final levels and profiles.

On completion of kerb and gutter a strip of kikuyu turf, a minimum of 0.9-metre wide, shall be placed adjacent to the kerb. This turf shall be maintained to provide a dense cover to act as a siltation barrier during the maintenance period.

6.15.9 Replacement of Incorrect and/or Damaged Construction

The Supervisor shall construct all kerb and/or gutter or subsidiary work in an efficient and workmanlike manner so that it will resist damage and/or displacement by weather conditions, road construction, builder's or other traffic and/or Service Authorities' plant, or undermining by the scouring away of the sub base materials.

Where kerb and/or gutter is damaged and/or displaced by such agencies after construction due to fault by other than Council, or is not constructed to specified line and level, it shall be removed and reconstructed by the Supervisor prior to the issue of the Subdivision Certificate. All costs associated with removing and reconstructing damaged or displaced works shall be borne by the developer.

6.16 CONCRETE FOOTPATHS, CYCLEWAYS AND SHARED WAYS

The concrete for footpaths, cycleways, shared ways and pathways, including strength, sampling, pavement and reinforcement where specified, shall be in all respects in accordance with the requirements of Sections 6.1 to Section 6.12 inclusive, of this Specification, except where a variation in those requirements are specified in the following sub sections.

6.16.1 Base

Base course material approved by Council and in accordance with Section 7 of this Specification shall be spread, levelled and compacted on the prepared sub base. The minimum compacted thickness of the base course material shall be 50-100 mm or as indicated by Council.

6.16.2 Joints

Joints shall be constructed for concrete paths in accordance with the following:

- (a) Footpaths;
 - (i) Transverse joints shall be struck in the footway paving at intervals of 1.2-metres, at locations adjacent to vehicular crossings or as directed by Council;
 - (ii) Expansion joints generally shall be provided at 6-metre intervals and shall consist of 6 mm thick chemically impregnated cork or other approved material.
 - (iii) Manufactured hinge joint systems shall be provided at all expansion joints and adjacent to trees to allow for controlled vertical movement without concrete failure;
- (b) Off Road Cycleways and Shared Ways;
 - (i) Transverse joints shall be struck in the footway paving at intervals of 1.5-metres, at locations adjacent to vehicular crossings or as directed by the Council;
 - (ii) Expansion joints generally shall be provided at 6-metre intervals and shall consist of 6 mm thick chemically impregnated cork or other approved material;
 - (iii) Manufactured hinge joint systems shall be provided at all expansion joints and adjacent to trees to allow for controlled vertical movement without concrete failure.

6.16.3 Finishing

The concrete shall be struck off with a screed and finished with wooden floats, followed by a light brooming at right angles to the centreline alignment of the pavement to provide a uniform non-slip surface. All edges and joints shall be finished forming a minimum 50 mm margin in a neat workmanlike manner.

6.16.4 Tolerances

Where the grade of the kerb and gutter is greater than 1% the tolerances on the level of the kerb, gutter and associated vehicle crossings shall be as set out in Section 9.16 of this Specification.

Where the grade of the kerb and gutter is less than 1% the tolerances on the level of the kerb, gutter and associated vehicle crossing shall be plus 10 mm and minus 10 mm.

In both cases, variations in level shall not be local and shall be over a length of 15-metres or more.

The tolerances on the horizontal shall be as follows:

- (a) Lateral position – 15 mm in 15-metres provided that the variations are not local or unsightly;
- (b) 150 mm horizontal tolerances on the chainage of vehicle crossings; and
- (c) 25 mm horizontal tolerances on the dimensions of vehicle crossings.

In the event of the tolerances being exceeded, the Council Engineer may at the Council Engineer's absolute discretion, order the Supervisor to carry out any reconstruction or remedial measures considered to be necessary or desirable.

6.16.5 Cleaning Up

Trimming of footways shall be completed within 7-days of the concrete being placed. An additional day's deferment of backfilling around gateways may be permitted to avoid damage to concrete paths

by vehicular traffic.

All footways for the full width adjacent to constructed paths shall be trimmed by cutting or filling where required and all areas of loose material; lightly compacted to the specified crossfalls and grades as shown on the Engineering Plans.

On completion of backfilling/trimming of the constructed paths a strip of kikuyu turf, a minimum of 0.9-metre wide, shall be placed adjacent to the kerb. This turf shall be maintained to provide a dense cover to act as a siltation barrier during the maintenance period.

6.17 DRAINAGE PITS

Drainage pits where practicable shall be benched internally with mass concrete to not less than one third of the outlet pipe diameter, notwithstanding that such benching may not be shown on the relevant Engineering Plans. All pits to be cast in-situ concrete unless otherwise approved by Council. No precast pits will be approved in public roads, Council drainage easements or trafficable areas.

Where drainage pits exceed 1.2-metres in depth as measured from the top of grate to the invert of the pit, galvanised step irons shall be provided in accordance with Standard Drawing No.SD20 whether shown on the Engineering Plans or not. Pits in excess of 1.5-metres are to be appropriately reinforced to a suitably qualified Civil or Structural Engineer's requirement.

Pits walls shall be formed on both the inside and outside faces. Pits shall be constructed in accordance with Standard Drawing Nos.SD12 and be of sufficient internal dimensions to ensure that pits are rectangular in nature and pipes are contained within a single face of the pit to avoid birds mouthing.

Subsoil drainage pipes laid in accordance with Section 5.14 of this Specification, shall be connected through the upstream pit wall and shall extend through any mass concrete benching so as to provide a free outlet.

Where directed by Council, a 150 mm diameter hole or 100 mm diameter dummy connection pipe shall be provided in drainage pit walls for future roof water connections. Where the drainage pit is at the kerb line, the invert of the hole or pipe shall be 600 mm below top of kerb. The pipe or wall opening shall be suitably blocked off.

6.18 PRECAST CONCRETE SECTIONS

Where indicated on the Engineering Plans or where authorised in writing by Council, precast concrete components shall be provided of the form and dimensions shown on the Standard Drawings and shall be constructed in the positions specified in all cases.

The Supervisor shall indicate the source of supply of the precast sections, and shall provide facilities for testing at the place of manufacture. The Supervisor shall signify in advance when each consignment of precast sections will be ready for dispatch so that prior arrangements may be made for inspection and testing.

The surfaces of the precast components shall be smooth, in true planes with square ends.

Patching and plastering of precast concrete sections will not be permitted. Sections shall be free from cracks, chips, porous spots or other visible defects. Precast stormwater pits will not be approved in public roads, Council drainage easements or trafficable areas.

6.19 CAST IRON AND STEEL FITTINGS

Cast iron gratings, frames and other fittings are to be to the requirements of AS1830 'Grey Cast Iron'.

Steel gratings, frames and other fittings are to be to the requirements of AS1204 'Structural Steels – Ordinary Weldable Grades'. They shall be hot dipped galvanized in accordance with AS/NZS4680 'Hot Dipped Galvanized Coatings on Ferrous Articles'.

Galvanised steel grates shall be of 'Weldlok' gully grate type GG78-51 or GG78-42A or equivalent with flat skirt base.

Fittings shall be to the grade and dimension shown on the Engineering Plans and/or Standard Drawings and shall be firmly and evenly bedded into the concrete structure.

6.20 PATTERN STENCILLED CONCRETE

Pattern stencilled concrete shall be provided as shown on the Engineering Plans. After screeding of the concrete the specified patterned paper moulding shall be aligned and stamped in place. The colouring shall be applied at the application rate and method specified by the manufacturer to a nominal 3 mm thickness.

Patterned stencilled concrete shall not be used on public roads

SECTION 7 - FLEXIBLE ROAD PAVEMENTS

7.1 DESCRIPTION

This Specification outlines the requirements for the construction of flexible road pavements. The Supervisor shall construct the flexible road pavement as shown on the Engineering Plans to the details specified and in accordance with this Specification.

This section excludes roundabouts. All new roundabouts are to be as rigid concrete pavement, overlaid by an asphaltic concrete wearing course.

7.2 PAVEMENT DESIGN

Flexible road pavement designs shall be prepared by a suitably qualified Civil or Geotechnical Engineer based on sampling and testing of the sub-grade and existing pavement materials by a NATA Registered Laboratory, in accordance with Section 2.5 of Council's Engineering Design Specification. Flexible road pavement shall consist of a sub base layer, a base course layer and a minimum 50 mm wearing surface assumed to provide no structural strength.

The granular materials for flexible road pavements shall be as shown on the Engineering Plans and specified in the formal pavement design. The base course shall be recessed as shown on the Engineering Plans, unless otherwise specified, to receive the thickness of the specified wearing course. The granular materials for used for flexible road pavements may be crushed and ripped sandstone, natural gravel, crushed rock or recycled materials meeting the requirements of this Specification.

The minimum material requirements shall be DGB20 for base courses and either DGB20 or DGS20 or crushed sandstone for sub base courses as shown on the Engineering Plans or otherwise specified and shall be to the requirements of Sections 7.4, 7.5, 7.7, 7.8 of this Specification.

7.2.1 Surfacing

The minimum surfacing requirement for flexible pavements in residential and industrial areas shall be a single coat flush seal with a 50 mm thick asphaltic concrete (AC10) surface applied in two 25 mm thick layers over the whole of the road pavement, in accordance with Section 2.5.3 of Council's Engineering Design Specification. The supply and construction of the asphaltic concrete wearing surface shall be in accordance with Section 10 of this Specification.

Except in the case of roundabouts, the placement of the final minimum 25 mm layer of AC10 will generally be delayed for a period of 12-months or until 80% of the dwellings have been erected within the subdivision.

Should it not be practicable to provide the final layer, the Supervisor will be required to lodge a bond with Council in accordance with Section 1.26.2 of this Specification.

Prior to sealing with asphaltic concrete a single coat hot bituminous emulsion seal of 10 mm aggregate shall be constructed in accordance with Section 9 of this Specification.

In rural areas a two (2) coat bituminous emulsion seal incorporating 20 mm and 10 mm aggregate will be required in lieu of the 50 mm AC10 specified above.

7.3 SUPPLY AND QUALITY OF MATERIAL

7.3.1 Sampling and Testing

The Supervisor shall supply details of the pavement materials proposed for use and the plant and methods which are to be used for winning, mixing (if any), spreading and compaction. Unless otherwise directed, the Supervisor will be responsible for testing the source of supply of materials, and for submitting samples (each about 15 kg in weight) when requested. It is the responsibility of the Supervisor to provide stockpile test results and/or quarry quality assurance documentation prior to incorporation of the pavement materials into the works.

No material shall be delivered or incorporated into the works until Council has notified approval in writing of the source of supply, and the plant and methods to be used in winning the material and constructing the pavement. Such approval will not relieve the Supervisor from the responsibility of arranging the winning, placement and compaction of the pavement materials to conform to this Specification. Any approval given to the source of supply of materials may be withdrawn if a significant number of samples taken from the pavement after compaction fail to comply with the specifications.

Material samples are to be taken for testing prior to the material being placed and compacted in the pavement. The frequency of sampling will be equivalent to one (1) sample per course for every 200-metres of road. Where materials do not meet the standard of the approved sample, then the Private Certifier or Council shall direct the removal of material from the site..

7.3.2 Site Stockpiles

Site stockpiles shall be formed on clean, even, well drained firm ground. Stockpiles of different materials shall be separated from each other and so positioned as to prevent cross contamination. No more than a total of 500 tonnes of material shall be stockpiled on any one site at a time.

Stockpiles shall be protected at all times in accordance with Section 11.5 of this Specification.

7.3.3 Delivery

The pavement materials shall be transported from the source of supply to the work in vehicles which are so constructed that loss of material does not occur. Material other than lime and cement treated crushed rock shall be supplied suitably damp to prevent segregation during transit, with a moisture content (uniformly distributed) between the Optimum Moisture Content and 3% below the Optimum Moisture Content at which the maximum density occurs in accordance with AS1289.5.1.1 'Dry Density/Moisture Content Relation of a Soil Using Standard Compactive Effort'.

The Supervisor shall register each delivery including the supplier's details or the stockpile from which the material is being supplied. All such documentation shall be made available for inspection by Council at any time.

7.4 CRUSHED OR RIPPED SANDSTONE

Where specified in the Engineering Plans crushed or ripped sandstone shall consist, as a minimum, of minus 75 mm nominal size derived from clean sandstone free from overburden, clay seams, shale and other deleterious material and shall meet the requirements of this Section of this Specification.

7.4.1 Material Requirements

The minimum grading limits applicable to crushed or ripped sandstone materials are listed in

Table 7.1.

Table 7.1 Minimum Grading Limits for Crushed or Ripped Sandstone

NOMINAL SIZE	% PASSING
75 mm	80-100
53 mm	75-100
37.5 mm	65-100
26.5 mm	57-100
19 mm	50-97
9.5 mm	37-86
4.75 mm	27-76
2.36 mm	20-65
1.18 mm	15-55
425µm	10-38
75µm	5-22

The material specifications applicable to crushed or ripped sandstone materials are shown in Table 7.2.

Table 7.2 Material Requirements for Crushed or Ripped Sandstone

TEST METHOD	PROPERTY	REQUIREMENT
AS1289.3.4.1	Linear Shrinkage	5% (max)
AS1289.3.1.1	Liquid Limit	23% (max)
AS1289.3.3.1	Plasticity Index	12% (max)
AS1289.6.1	Soaked CBR ⁽¹⁾	40% (min)

(1) Based on a 100% Standard Comp., 4.5 kg surcharge, 4-day test.

7.5 CRUSHED ROCK

Where specified in the Engineering Plans crushed rock shall consist of, as a minimum, tough, durable rock and shall include such added material as is necessary for the combined material to meet the requirements of RTA Specification 3051 'Unbound and Modified Base and Sub base Materials for Surfaced Road Pavements', to the standard of DGB20 and Section 7.5.1 of this Specification. The added material, if required, shall be mixed by blending uniformly with the crushed rock at the crushing point.

7.5.1 Material Requirements

The material requirements shown in Table 7.3 are to be determined after any pre treatment deemed necessary.

Table 7.3 Material Requirements for Crushed Rock

TEST METHOD	DESCRIPTION	DGB20	DGS20	DGB40
AS1289.3.6.1	Minimum Coarse Particle Size Distribution			
	% passing 53.0 mm sieve	-	-	100
	% passing 37.5 mm sieve	-	-	95-100
	% passing 26.5 mm sieve	100	100	70-90
	% passing 19.0 mm sieve	95-100	95-100	60-85
	% passing 13.2 mm sieve	75-90	70-90	50-75
	% passing 6.7 mm sieve	55-75	50-75	35-60
	% passing 2.36 mm sieve	35-55	30-55	25-50
AS1289.3.6.2	Minimum Fine Particle Size Distribution			
	Ratios (for that portion of the material passing 2.36 mm sieve)			
	A – Pass 425µm sieve (%)	40-60	38-62	38-62
	B – Pass 75µm sieve	40-60	38-62	68-62
	C – Below 13.5µm / Pass 75µm sieve (%)	40-60	38-62	38-62
AS1289.3.1.2	Liquid Limit (if not plastic)	20 ⁽¹⁾ (max)	23 (max)	23 (max)
AS1289.3.2.1	Plastic Limit (if plastic)	20 (max)	20 (max)	20 (max)
AS1289.3.3.1	Plasticity Index ⁽²⁾	6 (max)	12 (max)	12 (max)
RTA T114	Maximum Dry Compressive Strength of fraction passing a 19 mm sieve	1.7 MPa (min)	1.0 MPa (min)	1.0 MPa (min)
RTA T204	Los Angeles Test - % loss	40 (max)	50 (max)	50 (max)
RTA T213	Particle Shape of Proportional Calliper - % Misshapen (2:1)	35 (max)	40 (max)	40 (max)
RTA T215	10% Fines Value Dry – Wet / Dry (%) ⁽³⁾	35 (max)	35 (max)	35 (max)
RTA T215	Aggregate Wet Strength	100 kN (min)	100 kN (min)	100 kN (min)

(1) The maximum value of the Liquid Limit may be increased to twenty three (23) provided that the test value is not influenced by the presence of adverse constituents.

(2) After being subjected to pre treatment comprising five (5) cycles of compaction (RTA Test Method T102A) or to artificial weathering (RTA Test Method T103), the Plasticity Index shall not exceed six (6) for DGB20 material or twelve (12) for DGS40 material and it shall not increase by more than three (3) from that of the sample prior to pre-treatment.

After soaking in water at 65°C for up to 10-days the Plasticity Index shall not exceed six (6) for DGB20 material or twelve (12) for DGS40 material and it shall not have increased by more than three (3) from that of an equivalent portion of the sample tested without the soaking.

(3) When tested in accordance with RTA Test Method T215, in a saturated but surface dry condition after soaking in water for 24-hours, the 10% Fines Value of that portion of the sample passing the 13.3 mm sieve and retained on the 9.5 mm sieve shall not vary by more than 35% from that of an equivalent portion of the sample tested dry without soaking. Material retained on the 13.2 mm sieve may be crushed to make sufficient 13.2 mm to 9.5 mm sized material for the test.

7.6 RECYCLED MATERIALS

Where specified in the Engineering Plans recycled material may be used as either a sub base material or as a base course material providing such material is from a stockpile site certified by Council.

Where the recycled material is to be used as a base course it shall comply with RTA Specification 3051 'Unbound and Modified Base and Sub base Materials for Surfaced Road Pavements' and the requirements of this Specification and, irrespective of the road type or traffic category, shall have the following minimum properties:

- (a) Plasticity Index no greater than six (6);
- (b) Aggregate wet strength of not less than 70 kN; and
- (c) Wet/dry strength of not greater than 35%.
- (d) UCS value of maximum 1.0 MPa

The limit on foreign material that may be incorporated for a base course shall be in accordance with Table 7.4.

Table 7.4 Limits on Foreign Material in Base or Sub-base Course Materials

FOREIGN MATERIAL TYPE ⁽¹⁾		MAXIMUM LIMIT BY MASS OF BASE OR SUB-BASE
TYPE X	Metal, glass, asphalt, stone, ceramics and slag (other than blast furnace slag)	0.5%
TYPE Y	Plaster, clay lumps and other friable material	0.1%
TYPE Z	Rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter	0.1%

(1) Where a material is not specifically listed in the above Table 7.5, then the allowable maximum percentage shall be 0%.

The Supervisor must obtain the approval of Council prior to the application of recycled materials and such materials shall only be derived from a certified stockpile. Recycled material not derived from a certified stockpile shall be removed from the site at the developers expense.

It is the Supervisor's responsibility to provide the Council with delivery dockets for the materials sourced from certified stockpile sites. Delivery dockets shall clearly state the supplier, stockpile number and tonnes delivered.

7.7 SPREADING

Pavement material shall be spread on the sub-grade or base in uniform layers to provide the specified pavement thickness. No individual layer shall be more than 150 mm or less than 75 mm compacted thickness. Spreading shall be undertaken by a method which will ensure that segregation does not occur.

Prior to compaction, the moisture content of material, other than lime and cement treated material, shall be adjusted to achieve the optimum moisture content. Where necessary, water shall be added by an approved watering machine, and shall be mixed uniformly with the pavement material by an approved mechanical device. If there is existing excess moisture in the material, it shall be dried to the specified moisture content by loosening and aerating.

Pavement material shall not be spread upon a water logged sub-grade or sub base. If at any time the sub-grade or sub base material becomes rutted, or mixed with the pavement material, the Supervisor

shall at the developer's expense remove the material, reshape and compact the sub-grade or sub base material to the requirements of Section 4.6 and Section 7.11 of this Specification, and replace the pavement material with fresh material.

7.8 COMPACTING AND TRIMMING

Compaction shall take place at the moisture content deemed to be the Optimum Moisture Content (referred to as OMC) as determined in accordance with AS1289.5.1.1 'Dry Density/Moisture Content Relation of a Soil Using Standard Compactive Effort'.

The Supervisor shall ensure that the moisture content is kept to a workable minimum and under no circumstances will the moisture content exceed its Optimum Moisture Content or be less than 3% below the Optimum Moisture Content.

After the mixture has been brought to the specified moisture content, it shall be compacted immediately with approved equipment. The compaction shall begin at the sides and progress to the centre, parallel with the centre line of the roadway, uniformly lapping each proceeding pass and covering the surface completely. On superelevated curves the compaction shall commence at the lower edge and progress towards the upper edge of the pavement.

The surface of any compacted layer of material shall, on completion of compaction and immediately before preparation for the overlaying with the next layer, be of a roughened texture, free from compaction planes (false pavement), ridges, cracks or loose material. All segregated or otherwise defective areas shall be removed to the full thickness of the layer, re-laid with new material and re-compacted to the satisfaction of Council.

After the first course has been completed to the specified depth and density and after proof rolling has been inspected by Council, the second course shall be uniformly spread on the prepared surface and similarly treated. The top of each course shall be graded and trimmed generally to line and level. Where the compacted surface is below the specified level, the defective areas shall be removed to the full thickness of the layer, re-laid with new material and recompacted, to produce a surface generally parallel to the designed finished surface of the roadway, as shown on the Engineering Plans to the satisfaction of Council.

Variations in the compacted thickness of each course shall not exceed plus 12 mm and minus 15 mm. The finished surface level shall not deviate from the bottom of a three metre straight edge, laid in any direction, by more than 12 mm in the case of lower courses, and by more than 6 mm in the case of the upper course. The finished surface level of the upper course shall not vary more than 15 mm from the planned grade at any point.

Any irregularities in excess of the tolerances stated above shall be corrected by loosening the surfaces, removing or adding pavement material as required and recompacting the area to a uniform surface conforming to the designed cross section and grade. In no case shall quarry dust or other fine materials be used to build up depressions.

Compaction of base courses shall continue until there is no visible movement of the pavement under the proof roller as directed in Section 7.13 of this Specification.

In general, the minimum compaction requirements for each layer in the pavement during construction shall be in accordance with Table 7.5:

Table 7.5 Minimum Compaction Requirements

PAVEMENT LAYER	COMPACTION REQUIREMENTS ⁽¹⁾
Fill (other than road pavement)	Density Ratio 95% standard
Sub-grade layer and fill under road pavement	Density Ratio 100% standard

Sub base course	Density Ratio 98% modified
Base course	Density Ratio 98% modified

(1) Where the density ratio is Field Dry Density / Maximum Dry Density x 100%

All tests are to be undertaken in accordance with AS1289. No tests shall fall below the required density specified above.

Where necessary, the Supervisor shall be instructed by Council to recompact the materials or take other appropriate remedial action in accordance with Section 7.14 of this Specification.

7.9 COMPACTION TESTING

The Supervisor shall arrange and bear the cost of all pavement compaction testing required by this Section of the Specification.

Sub base, base course and sub-grade compaction requirements shall be as shown in Table 7.6.

All testing shall be carried out by a NATA Registered Laboratory. All testing shall be in accordance with the procedures detailed in AS1289.5.4.1 'Compaction Control Test - Dry Density Ratio, Moisture Variation and Moisture Ratio'.

Frequency of testing shall be in accordance with AS1289 'Methods of Testing Soils for Engineering Purposes', AS1726 'Geotechnical Site Investigations' and Section 2.5.2 of Council's Engineering Design Specification. As a minimum, a compaction test will be required for every 50-m section of lane width and/or at other locations as identified by Council Engineers.

7.10 PROOF TESTING

After the each pavement course has been completed to the specified depth and density, the Supervisor shall make available a three (3) wheeled self propelled roller and shall carry out proof loading by rolling that prepared pavement layer. Approval to construct subsequent pavement layers may be given only after the Council has inspected the proof rolling.

The self-propelled roller shall exceed 9000 kg in weight, have rear rolls of 1200 mm diameter and an intensity of loading of 7000 kg per metre width of roll, unless otherwise approved by Council.

7.11 DEFECTIVE MATERIAL

If at any time during the progress of the work, any material supplied is found to be not in accordance with this Specification, Council will direct the Supervisor to remove the unsuitable material and replace it with satisfactory material. Previous acceptance of the whole or part of the material by Council shall not restrict Council's right to direct removal and replacement of material subsequently found to be unsatisfactory. The Supervisor shall carry out such remedial work immediately and all costs associated such remedial works shall be borne by the developer.

7.12 COMPLETED PAVEMENT SURFACE

The completed pavement shall show no visible cracking of a structural nature and shall have a uniform, hard, monolithic surface, which shows no visible movement under the roller and in which the pavement particles are tightly and uniformly embedded in a gritty, cementitious matrix.

When final sweeping of the pavement is carried out immediately prior to the application of bituminous surfacing materials, the coarse particles of the surface course shall be bared but not dislodged and

shall be free of all slurry and/or dust which, in the opinions of Council, may interfere with the proper adherence of the bituminous materials to the pavement surface.

Prior to the application of the bituminous wearing course, the Supervisor shall maintain the pavement in the above condition to the satisfaction of Council.

7.13 MAINTENANCE

Should any defect appear in the pavement during the project and maintenance period, whether before or after bituminous surfacing, such defect shall be made good by the Supervisor. All costs associated with such works shall be borne by the developer. Such areas shall be loosened, defective material shall be removed, fresh pavement material shall be added, and the areas shall be re-compacted, trimmed and sealed to produce a pavement which conforms to the Specification and blends with the adjacent pavement.

SECTION 8 - PAVING UNITS

8.1 DESCRIPTION

Paving units shall be provided to areas shown on Engineering Plans true to all grades, levels and curves as required. Paving Units shall be laid to give a uniform and regular pattern.

8.2 PAVING UNITS

8.2.1 Concrete

Concrete paving units shall be shape Type A units complying with Section 8.9 of this Specification and shall have a characteristic compressive strength of 45 MPa when sampled and tested in accordance with AS/NZS4456 'Masonry Units, Segmental Pavers and Flags - Methods of Test' unless otherwise approved by Council and shall be of 80 mm thickness.

8.2.2 Clay

Clay paving units shall be fired Clay Pavers Class 4 and shall comply with AS/NZS4455 'Masonry Units and Segmental Pavers' and Section 8.9 of this Specification and shall be of 65 mm thickness with round arises to four (4) sides of the wearing surface but not exceed 5 mm radius.

Clay paving units are not to be used for roads.

8.2.3 Sub-grade, Base Course and Sub-Base Course For Roads

The concrete for paving units in roads including strength, sampling and reinforcement where specified, shall be in all respects in accordance with the requirements of Sections 6.1 to Section 6.13 inclusive, of this Specification, except where a variation in those requirements are specified below.

Pavements layers are generally to be constructed in accordance with the formal pavement design show on the Engineering Plans and as prepared by a suitable qualified Structural or Civil Engineer.

The base course and sub base course shall extend to the rear face of all edge restraints, unless otherwise specified and shall be inspected and approved by Council prior to commencing the placement of the sand bedding course and the laying of units.

Control joints shall be constructed at 20-metre maximum intervals.

8.3 EDGE RESTRAINTS

Concrete kerbs and gutters, kerbs and edge strips shall be constructed to the details shown on the Engineering Plans and in accordance with this Specification and to the requirements of Standard Drawing No.SD02.

8.4 SURFACE DRAINAGE

After completion of the paving units, their upper surface shall finish sufficiently above the levels of adjacent surface drainage channels, edge strips or drainage inlet pits to ensure positive drainage from the grooves formed between adjacent units. Where this is not detailed on the Engineering Plans the units shall be laid ensuring that the lower edges of chamfers finish not less than 5 mm above the

lip of edge restraints.

8.5 BEDDING SAND

8.5.1 Material

Bedding sand shall be well graded angular, non cohesive sand passing a 4.75 mm sieve and conforming to the grading limits shown in Table 8.1:

Table 8.1 Grading Requirement for Bedding Sand

SIEVE SIZE	9.52 mm	4.75 mm	2.36 mm	1.18 mm	600µm	300µm	150µm	75µm
% PASSING	100	95-100	80-100	50-85	25-60	10-30	5-15	0-10

The bedding sand shall be free of deleterious soluble salts or other contaminants likely to cause efflorescence or otherwise leading to reduced skid resistance. A weed killer, approved by Council, shall be added to the bedding sand to avoid growth appearing through joints.

Bricklayers sand and single sized dune sands are not suitable.

Bedding sand shall be supplemented with cement when placed under roads. The sand-cement bedding mixture shall consist of three (3) parts sand, one (1) part cement and one (1) part water. Cement shall be provided in accordance with Section 6.4.1 of this Specification.

8.5.2 Moisture Content

The sand shall be of uniform moisture content when spread and shall be protected from rain when stockpiled on site prior to spreading. Moisture contents in the range 4% to 8%.

8.5.3 Spreading

The bedding shall be spread and screeded in a loose condition to the design profile and levels plus the necessary surcharge to achieve a uniformly 20 mm thick layer following final compaction of the pavement.

The spread sand shall be carefully maintained in a loose condition and protected against pre-compaction both prior to and following screeding. Any pre-compacted sand or sand left overnight shall be loosened before further paving units are placed. Sand shall be lightly screeded in a loose condition to the predetermined depths only slightly ahead of the laying of paving units. Under no circumstances shall the sand be screed in advance of the laying face to an extent to which paving will not be completed on that day.

8.6 PLACEMENT OF PAVING UNITS

Where possible paving units shall be placed so that they do not come into contact with adjoining units, whilst maintaining correct joint alignment using a grid of string lines. Unless advised otherwise by the Council Engineer pavers shall be laid in either 45-degree or 90-degree herringbone with a nominal joint width of 2 mm to 3 mm unless otherwise specified.

It is the Supervisor's responsibility to ensure the best laying face is chosen when laying double faced units.

In each row all full units shall be laid first. Closure pavers (cut to fill gaps adjacent to edge) should

then be laid subsequently. Units shall be cut by power sawing.

The first row shall be laid at a suitable angle to achieve the required orientation of paving units in the completed pavement. Edge or closure units shall be neatly cut to fill gaps. Such units shall consist of not less than 25% of full unit surface area. Cutting of units to less than 25% of size should be avoided by using insertions of half or three quarter units.

Should it be necessary to manipulate individual paving units to ensure correct joint alignment and to ensure that no paving units are in point contact with each other a brick bolster shall be used. Under no circumstances shall screw drivers or other implements likely to cause edge damage to the paving units be used.

Paving units shall be blended from various packs to ensure uniform spread of colour.

8.7 COMPACTION OF PAVING UNITS AND JOINT FILLING

8.7.1 General

Joint filling sand shall be a clean fine graded rounded sand, free from deleterious materials such as clay and soluble salts or other contaminants. Additives are to be incorporated in the jointing sand to provide bound and pliable joints and are to be used in accordance with manufacturer's specifications. Cement additives are not to be used.

The joint filling sand shall conform to the grading shown in Table 8.2:

Table 8.2 Grading Requirement for Joint Filling Sand

SIEVE SIZE	% PASSING
2.36 mm	100
1.18 mm	75-95
600µm	50-80
300µm	20-45
150µm	5-15
75µm	0-5

A thin layer of joint filling sand should be spread evenly over the paving units prior to compaction to aid the movement of the compactor and minimise surface damage.

The paving units shall be compacted and brought to level using a high frequency, low amplitude, vibrating plate compactor. The plate shall be of sufficient size to simultaneously cover a minimum of twelve (12) pavers. A suitable resilient material such as plywood, with a minimum thickness of 12 mm shall be placed between the vibrating plate and the paving units, to provide a cushioning effect. Care shall be taken to ensure that direct contact between the steel plate of the compactor and the paving unit surface is minimised as direct contact will weaken the edges of the paving units resulting in subsequent spalling.

After initial compaction, the whole sequence of spreading and brushing in jointing sand, removing the surplus and vibrating with two (2) or three (3) passes of the plate compactor is to be repeated.

Compaction shall be undertaken as soon as reasonably practicable after placing paving units, though it should not be performed closer than 1-metre from any unrestrained edge. Compaction shall continue until lipping has been eliminated between adjoining paving units. To ensure complete filling of the joints, both the joint filling sand and paving units shall be as dry as practicable. Ideally, joint filling shall be carried out prior to the completion of each day's laying.

Under no circumstances should traffic, including construction traffic, be allowed onto the segmental pavement prior to the completion of the laying, cutting in, compacting and joint filling process.

Where traffic volumes and/or the frequency of heavy vehicles are anticipated to be high, additional compaction by approved multi wheeled pneumatic type road rollers shall be required.

8.7.2 Damaged Units

Any paving units not complying with the acceptance criteria hereinafter described, or damaged during compaction, shall be immediately removed and replaced. In the case of double faced paving units, the paving units can be turned over if the alternative face meets the acceptance criteria. Where possible, pavers rejected should be used as closure units or infill pieces to minimise wastage.

8.7.3 Maintenance

All pavements shall be maintained by the Supervisor during the Maintenance Period.

8.8 ACCEPTANCE CRITERIA FOR PAVING UNITS

Paving units shall be provided to areas shown on Engineering Plans.

All paving units shall be provided in compliance with the following acceptance criteria. Any paving units not complying with the acceptance criteria shall be immediately removed and replaced.

The pavers shall carry a certificate from a NATA Registered Laboratory to show the compliance with the requirements detailed in Sections 8.9.4 to 8.9.11 of this Specification.

8.8.1 Dimensions

The pavers shall be of rectangular shape and nominally 230 mm long, 114 mm wide when actual dimensions are measured in accordance with AS/NZS4456 'Masonry Units and Segmental Pavers and Flags – Methods of Test'. Concrete pavers shall be 80 mm thick in accordance with Section 8.2.1 of this Specification. Clay pavers shall be nominally 65 mm thick in accordance with Section 8.2.2 of this Specification and shall not be used in roads.

The actual dimensions measured shall be such that the following tolerances are not exceeded:

- (a) Plus or minus 40 mm on the length of twenty (20) pavers;
- (b) Plus or minus 40 mm on the width of twenty (20) pavers; and
- (c) Plus or minus 40 mm on the depth of twenty (20) pavers.

8.8.2 Edge Treatment

The pavers shall have chamfered or round edges on all four (4) sides in the finished pavement surface. The radius of the rounded edge however, shall not exceed 5 mm.

8.8.3 Wearing Surface

Pavers shall have a re-rolled finish rather than a wire cut finish. All wearing surfaces shall be smooth and non-slip with no sharp projections.

8.8.4 Abrasion Resistance

Abrasion resistance shall not exceed a loss of 3.5-cubic centimetres on any one (1) unit when tested in accordance with AS/NZS4456.

8.8.5 Characteristic Compressive Strength

Characteristic compressive strength of concrete pavers shall be a minimum value of 45 MPa when tested in accordance with AS/NS4456.

8.8.6 Cold Water Absorption

Cold Water Absorption shall not exceed 8% when tested in accordance with AS/NS4456.

8.8.7 Efflorescence

Efflorescence shall be nil when tested in accordance with AS/NS4456.

8.8.8 Lime Pitting

Lime pitting shall be nil when tested in accordance with AS/NS4456.

8.8.9 Slip/Skid Resistance

The slip/skid resistance or coefficient of friction shall achieve a Class W BPN of forty-five (45) to fifty (50) when tested in accordance with AS/NS4456 and AS/NZS3661 'Slip Resistance of Pedestrian Surfaces'.

8.8.10 Transverse Breaking Load

The transverse breaking load shall be a minimum value of 5 kN when tested in accordance with AS/NS4456.

SECTION 9 - SPRAYED BITUMINOUS SURFACING

9.1 DESCRIPTION

This Specification provides for the spraying of hot bitumen and the application of a suitable precoated aggregate to an existing sealed surface or an unsealed prepared surface.

Sprayed bituminous surfacing shall be in one or two applications in accordance with Section 7.2 of this Specification, and/or as directed on the Engineering Plans.

The work shall include the following:-

- (a) Supply of materials;
- (b) Sweeping of pavement;
- (c) Heating, cutting back binder in the field and applying binder for seal coats;
- (d) Heating and applying cutback binder prepared at the refinery or other source of supply;
- (e) Pre-coating of aggregate for seal coats;
- (f) Application of aggregate for seal coats;
- (g) Rolling and incorporation of aggregate for seal coats; and
- (h) Maintenance of work after completion.

In multiple application treatments, each application of binder shall be covered with aggregate and roller as specified, before the subsequent application of binder.

No sealing work shall be carried out while the pavement temperature is less than 10°C in the shade, or during periods of wet weather, unless authorised by Council.

9.2 SUPPLY OF MATERIALS

The Supervisor shall be responsible for supply of the various materials required.

The Supervisor shall be responsible for the safe custody of all materials until they are in place on the road, and shall take all necessary precautions to avoid loss by fire or damage by water, and shall bear the cost of any such material that is lost, spilt or destroyed.

9.3 MEASUREMENT OF MATERIALS

Unless otherwise stated all rates and quantities in this Section relating to binder and cutter oil shall refer to measurement by volume at 15°C.

9.4 QUALITY OF MATERIALS

9.4.1 Binder

Bitumen shall conform to the AS2008 'Residual Bitumen for Pavements' and RTA Specification 3253 'Bitumen for Pavements'. Applicable grades are to be determined by an appropriately qualified Civil or Geotechnical Engineer.

9.4.2 Cutter Oil

Cutter Oil shall conform to AS3568 'Oils for Reducing the Viscosity of Residual Bitumen for Pavements'. Applicable grades are to be determined by an appropriately qualified Civil or Geotechnical Engineer

9.4.3 Refinery Cutback Bitumen

Refinery cutback bitumen shall conform to AS2157 'Cutback Bitumen' and RTA Specification 3261 'Cutback Bitumen'. Applicable grades are to be determined by an appropriately qualified Civil or Geotechnical Engineer

9.4.4 Pre-coating Materials

Pre-coating materials shall conform to the RTA Specification 3151 'Supply and Delivery of Cover Aggregate for Sprayed Bituminous Surfacing'. These may be coal tars, cutback bitumen, oil based materials with additives, bitumen based materials with additives, bitumen based materials with additives or water based materials with additives.

9.4.5 Aggregate

Aggregate shall conform to the AS2758 'Aggregate for sprayed bituminous surfacing' and RTA Specification 3151 'Supply and Delivery of Cover Aggregate for Sprayed Bituminous Surfacing'.

The nominal size of the aggregate shall be 20 mm for the first seal coat of a two (2) coat application. The nominal size of aggregate shall be 10 mm for a single coat application or for the second seal coat of a two (2) coat application. In rural road works a two (2) coat seal comprising 20 mm and 10 mm aggregate may be required by Council. All aggregate must be precoated.

9.5 SAMPLING OF MATERIALS

The Supervisor may be required to supply at any time without charge, adequate samples of any or all materials used or to be used in the work.

The samples shall be taken by the Supervisor in the presence of Council when and where directed by Council. The time of sampling may be either prior to dispatch of the material from source of supply or subsequent to its arrival at the job or both. The Supervisor shall supply all facilities, equipment and labour for obtaining the samples.

The methods of sampling and testing shall be those described under the relevant materials specification contained in Section 9.4 of this Specification where applicable. If any sample fails to conform to the specified requirements, the whole of the material represented by such sample may be subject to rejection or other action as described in Section 9.17 of this Specification.

9.6 PLANT

The Supervisor shall provide all the plant and equipment necessary for carrying out the work in accordance with this Specification. The Supervisor shall indicate to Council prior to commencement of the work, the make, model, and capacity or mass of the plant items proposed to be used on the work.

All plant and equipment used on the work shall be kept in good operating condition and kept free from oil, water or chemical leaks. The Supervisor shall remove from the work any plant or equipment

considered by Council to be unsuitable for carrying out the work in accordance with this specification.

9.7 PREPARATION OF PAVEMENT

The surface of the pavement shall be swept free of loose stones, dust, dirt and foreign matter so as to uncover but not dislodge the stones of the pavement immediately before applying the first coat. Sweeping shall extend a minimum of 250 mm clear of the pavement where concrete does not exist and 100 mm clear of the pavement where concrete does exist.

A mechanically operated rotary broom may be used for the sweeping provided it does not disturb the surface stones. If this does not provide a satisfactory clean surface, additional sweeping shall be done by hand using stiff base or similar approved brooms. Any adherent patches of foreign material shall be removed from the surface of the road.

Where the existing pavement is recessed below the gutter lip, additional sweeping shall be done by hand adjacent to the lip to remove all loose material.

No spraying shall be undertaken until the prepared pavement has been inspected and approved by Council in accordance with Section 1.4 of this Specification.

9.8 CONTROL OF WORK

No spraying shall be carried out on a wet pavement, while rain appears imminent, or during high winds or dust storms. Council may order work to cease temporarily on account of adverse weather, unsatisfactory condition of pavement or aggregate, or any circumstances which Council considers may affect the work adversely.

Council may direct the width, length, alignment and section of road to be sprayed at any time. Provided the width of treatment does not exceed 7.4-metres, Council may direct whether spraying is to be carried out to the full width of the treatment or in part widths. Where part width spraying is to be carried out, the work shall be arranged to provide for a reasonably continuous flow of at least one (1) lane of traffic.

The sprayer shall be so guided that the edge of the spray conforms at all times to the line ordered. Any strips of pavement not adequately covered by binder shall be sprayed later by the hand attachment.

To ensure the consistent application of the sprayed bituminous surfacing, the Supervisor may vary the proportion of cutter oil in the binder at any stage of the work.

Binder, aggregate or other materials used in the work shall be prevented from entering or adhering to kerb and gutter, gully pits, hydrants, valve boxes, manhole covers, bridge decks, culverts and similar road fixtures. The Supervisor shall take all necessary precautions and shall take steps immediately after aggregate has been spread over the binder to clean off any material and leave the site of the work in a clean condition.

9.9 OPERATION OF SPRAYER

Unless otherwise authorised by Council and except as stated hereunder in this Section, the application of binder shall be made by means of the mechanical sprayer.

Where the use of the mechanical sprayer is not practicable for the spray application, such as for the correction of minor irregularities or in small areas inaccessible to mechanical sprayers, Council may approve the spraying to be undertaken by means of the hand spray equipment attached to the sprayer.

The spray nozzles shall be of the make and type endorsed on the Sprayer Certificate. Any nozzles which may be damaged or become unduly worn or defective shall be replaced by satisfactory nozzles of similar type. A sufficient number of nozzles for this purpose shall be available at all times.

The Supervisor shall measure and mark on the ground the length of the surface to be sprayed by each 'run' of the sprayer. The Supervisor shall indicate by marks on the road at intervals of not more than 7-metres, the line to be followed by the sprayer for the spray to conform to the alignment ordered. The existing gutter lip may be used as the line to be followed where appropriate. Where part-width spraying is ordered, the application on each width shall be so arranged as to provide for a lap of 50 mm at the longitudinal joint with the adjacent. If intermediate nozzles are used as end nozzles, the overlap of spray between adjacent runs shall be 300 mm.

The sprayer shall maintain a uniform rate of application throughout the length of each sprayer run. Binder shall be applied at the rate specified in Section 9.13 of this Specification

To avoid air entrainment within the delivery system of the sprayer and to provide for minor excess in the rate of spray, provision shall be made for 10% or such other percentage as may be determined by Council of the rated capacity of the sprayer tank to be retained in the tank at the completion of each run.

After each sprayer run, the quantity of material sprayed shall be checked against the area covered and any necessary adjustments shall be made to ensure that the specified or ordered rate of application is maintained in subsequent runs.

Spraying shall cease immediately if any defect develops in the spraying equipment, and it shall not recommence until the fault has been rectified.

Council may require such tests as it considers necessary to check the performance of the sprayer and its equipment. As and when directed by Council, the Supervisor, at the developer's own cost, shall make the sprayer and its equipment available for field testing, and shall supply any assistance required for the purpose. Any sprayer which does not operate satisfactorily, or conform to the requirements of this Specification in all respects, may be rejected by Council for further use on the work.

9.10 HEATING OF BINDER

Binder shall be heated to a temperature necessary to carry out the operations of cutting (if required) and spraying. The temperature of the binder at the time of spraying shall be within the limits given in Table 9.2 presented below. At no time during heating in the field shall the specified upper limit be exceeded. Any binder which in the Council Engineer's opinion, has been damaged by overheating, shall be rejected and shall be replaced at the developer's expense.

Table 9.2 Binder Temperature at Time of Spraying

TYPE OF MATERIAL	GRADE	DYNAMIC VISCOSITY RANGE IN PA.S AT 60°C	TEMPERATURE RANGE FOR HEATING AND SPRAYING (°C)
Cutback Bitumen	AMC 4	2.0 – 4.0	110 – 135
	AMC 5	5.5 – 11.0	120 – 150
	AMC 6	13.0 – 26.0	135 – 160
	AMC 7	43.0 – 86.0	150 – 175
Bitumen	Class 170	140 – 200	160 - 190
	Class 320	140 – 200	170 - 200

Binders shall be heated in equipment which will permit uniform heating without damage to the

content. Quantities of binder in excess of requirements shall not be heated, and such materials shall not be held at temperatures within the spraying range for periods in excess of 10-hours.

During the heating of binders, temperatures shall be checked regularly by means of a mercury-in-steel dial thermometer, or a maximum recording mercury-glass thermometer or other approved means. The instrument shall be such that the readings are within plus or minus 2.5% of the correct temperature.

Two (2) or more suitable fully-charged pressurised dry chemical fire extinguishers shall be provided, and shall be placed conveniently to the heaters at all times while heating is in progress. An adequate quantity of suitable loose sandy material shall also be provided at the heaters for use in the event of fire.

All binders shall be sprayed as soon as possible after heating. If for any reason binder cannot be sprayed on the same day that it is mixed with cutting oil, then it shall only be used subsequently if, in the opinion of the Council Engineer, it has not been damaged by prolonged or excessive heating.

When binders are delivered from a refinery or a major supply depot to the site of the work in large closed containers, insulated to minimise loss of heat in transit, the contents at the time of dispatch may be at a temperature not more than 15°C in excess of the upper limit given in Table 9.2.

Bituminous materials which have cooled, and are not sufficiently fluid, shall be heated at a slow rate until the whole mass becomes fluid. The temperature of the material just above the heating tubes shall be checked at regular intervals to ensure that there is no local overheating. Burners shall not be used unless the level of the material in the heating tank is at least 250 mm above the tops of the heating tubes.

9.11 CUTBACK BITUMEN BINDER

The Supervisor shall arrange for the binder in each sprayer load to be cutback as if required and each sprayer load shall be accompanied by a certificate showing the volume of bitumen and cutter oil material respectively used.

The percentage of cutter oil to be used in the cutback bitumen binder at any time during the course of the work shall generally be determined from the recorded road temperature and Table 9.4.

As a short period of time will elapse between taking road temperatures and spraying the cutback bitumen, it is necessary to make an estimate of the change in temperature during that period. The estimated temperature at time of spraying is then used for selecting the amount of cutter oil from the cutback chart.

Except as may be authorised otherwise by Council, the cutter oil, without being previously heated, shall be pumped into the sprayer, followed by the hot bitumen. The full sprayer load of binder shall be circulated for at least 15-minutes, or any greater time necessary to ensure that the mixture is homogeneous.

Precautions are to be taken to reduce the possibility of foaming during the mixing of cutter oil and bitumen.

When mixing cutter oil and bitumen in the sprayer, an empty drum or other container should be placed beneath the overflow pipe to catch any material discharged through foaming. Anti-foam preparations are not to be used except with the approval of Council.

If a part sprayer load of field cutback bitumen is unused on the date of mixing and needs to be returned to the heater tanks, it shall be placed in an empty tank reserved for that purpose. No bitumen or cutter oil shall be added to the returned material unless the tank is fitted with an effective mechanical mixing system.

When the returned material is subsequently used as part of a sprayer load, allowance shall be made for the cutter oil contained in the returned material.

9.12 MEASURING ROAD TEMPERATURES

Unless advised by Council, the temperature of the road shall be measured and recorded at regular intervals during the course of the work to ensure the correct percentage of cutter oil is incorporated into the binder in accordance with Table 9.4.

For this purpose a spirit or mercury-glass thermometer or other suitable thermometer shall be placed in direct contact with the pavement and allowed to remain in position until the reading becomes steady. The bulb of the thermometer shall be covered with a small heap of dust or grit taken from the road surface. When the temperature of a sealed pavement is being measured, the bulb of the thermometer shall be coated with black paint or cutback bitumen.

If the pavement is partly in sun and partly in shade, the temperatures for both conditions shall be taken and recorded.

9.13 APPLICATION OF BINDER

The binder shall consist of bitumen or cutback bitumen prepared in a bitumen refinery or other source of supply as scheduled in Table 9.2, or cutback bitumen prepared in the field in accordance with Section 9.12 of this Specification.

The net cold rate of application of the binder unless otherwise specified, shall be in accordance with Table 9.3:

Table 9.3 Net Cold Rate of Application of Binder

SINGLE COAT	
seal or reseal	1.2 litre per square metre
TWO COAT SEAL	
1 st application	1.3 litres per square metre
2 nd application	1.1 litres per square metre

The Principal Certifying Authority may order variations in the specified rates of application at any stage of the work.

When refinery cutback bitumen is used as the binder, the ordered rate for residual bitumen shall be increased, to allow for cutter oil in the mixture, in accordance with Table 9.4:

Table 9.4 Increase in Ordered Rate of Application to Allow for Cutter Oil

GRADE OF CUTBACK BITUMEN	APPROXIMATE AMOUNT OF CUTTER OIL (%)	INCREASE IN ORDERED RATE (%)	PERMISSIBLE RANGE OF ROAD TEMP AGGREGATE PRECOATED ⁽¹⁾	
			NO MOISTURE ON AGGREGATE (°C)	MOISTURE ON AGGREGATE (°C)
AMC 4	16	19	-	10-15
AMC 5	11	12	12-17	12-28
AMC 6	7	8	22-27	22-38
AMC 7	3	3	32-37	32-48

(1)The ranges of road temperatures do not apply when refinery cutback bitumen is used on sandstone

pavements. Manufacturers specifications are to be referenced.

When refinery cutback bitumen is in use, and actual road temperatures are outside the permissible range given in table presented above, the Supervisor shall defer spraying until the road temperature comes within that range. Alternatively, in the case when the road temperature is too low, the Supervisor may add extra cutter oil to the binder as directed by Council. Any additional cutter oil shall be mixed uniformly with the binder.

The binder shall be applied to the prepared road surface in the manner specified in Section 9.9 of this Specification, at a rate of application within a tolerance of plus or minus 5% of that specified by Council. If binder is applied at a rate outside this tolerance, the section of work concerned may be rejected by Council.

The temperature of the binder at the time of spraying shall be within the range specified in Section 9.10 of this Specification. The binder shall not be heated in the field in excess of the maximum temperature specified in Section 9.10 of this Specification and shall be sprayed as soon as possible after heating.

At the time of spraying, the road surface shall be clean and free from loose material and where binder is to be applied to a primed or sealed pavement, the surface shall be dry. Where binder is to be applied to a pavement not previously primed or sealed, the surface shall be slightly damp, unless a direction to the contrary is given by Council.

Unless otherwise authorised by the Principal Certifying Authority, spraying shall not be done unless the road temperature has been at or above 10°C for at least 1-hour prior to the commencement of spraying operations. Road temperatures shall be measured as set out in Section 9.12 of this Specification. Spraying shall not proceed if rain appears imminent, or during high winds or dust storms, except as may be authorised by Council.

The area to be sprayed with binder at any time shall be limited to that which can be covered with aggregate at the specified rate within 20-minutes of the time of spraying.

9.14 PRE-COATING OF AGGREGATE

All cover aggregate shall be coated with an approved agent and at an application rate nominated by the Supervisor. The application rate shall generally be in the range of six (6) to fifteen (15) litres per cubic metre.

Pre-coating material shall be thinly and evenly applied to a moving stream of aggregate so that all particles are fully coated, but do not contain excess material.

This shall be achieved by means of a fine pressure spray or by mixing with the aggregate in an approved mixing plant. The coating shall be such that no material will drip from a particle of aggregate suspended between the fingers. The method of pre-coating and the apparatus to be used shall be as approved by Council.

When precoated material is being applied, the aggregate may be dry or damp, but shall not contain sufficient moisture to cause uneven distribution of the pre-coating material on the aggregate particles.

Pre-coating of damp aggregate shall not be carried out when rain is imminent, unless Council has authorised the mixing of an adhesion agent in the pre-coating material or the aggregate is adequately covered to prevent the pre-coating material from being washed from the aggregate.

Aggregate which contains moisture at the time of pre-coating shall not be used in the work until the moisture has evaporated and the pre-coating material has adhered effectively to the aggregate.

Precoated aggregate shall be used within 10-days of pre-coating and not earlier than 2-days of such treatment, unless a direction to the contrary is given by Council.

In areas subject to dusty conditions, precoated aggregate shall not be stockpiled for any period longer than is necessary for moisture to dry out unless stockpiles are covered. If dust has blown into stockpiles of precoated aggregate and there is a visible coating of dust on the particles, Council may direct that portions of the stockpiles be precoated again.

9.15 APPLICATION, DISTRIBUTION AND INCORPORATION OF AGGREGATE

After spraying the binder, aggregate as specified shall be spread uniformly over the sprayed surface by an approved mechanical spreader.

The rate of application of the aggregate, unless otherwise specified, shall be in accordance with Table 9.5:

Table 9.5 Rate of Application of Aggregate

SINGLE COAT SEAL OR RESEAL	
seal or reseal	1 cubic metre per 120 square metres
TWO COAT SEAL	
1 st application	1 cubic metre per 90 square metres
2 nd application	1 cubic metre per 120 square metres

Council shall have the right to order variations in the specified rates of application at any stage of the work. In all cases the following procedure shall be adopted.

Sufficient loaded trucks shall be at the site to provide the full aggregate cover required for the quantity of binder to be sprayed at that time. Aggregate at site shall be sufficient to re-run or hand cover bare or insufficiently covered places left after the first spreading.

The application of aggregate shall commence immediately after the spraying of the binder and shall be completed with 20-minutes of spraying. If any delay occurs in the application of the aggregate, spraying shall be immediately suspended. Bare or insufficiently covered places shall be re-run with the mechanical spreader or covered by hand as Council may direct. Aggregate in excess of the rate of application specified or ordered shall be scattered and evenly distributed on the road or otherwise removed and stock piled in an approved manner.

The aggregate shall be so placed that the particles are bedded against one another to form a dense mosaic of single particle thickness without loose particles resting on the mosaic. In order to meet this requirement, it may be necessary to apply the aggregate initially at a rate slightly less than the optimum and finish with a further light application to make good any minor deficiencies in the aggregate cover. Council will order any minor changes in the spreading rate to achieve the results required.

In two (2) coat work, before the second course of binder is applied, the first course of aggregate shall be incorporated thoroughly into the binder, and if there are any surplus loose particles on any portions of the sealed area, such portions shall be swept lightly, so as to remove the loose particles, but not disturb the aggregate bedded in the binder.

This work shall proceed as soon as the first course of aggregate is firmly held by the binder. After the second application of binder and aggregate, rolling and any necessary drag brooming shall proceed as specified herein.

After the aggregate has been applied to the satisfaction of Council, it shall be rolled with one or more pneumatic tyred rollers of the type listed in Section 9.6 of this Specification.

Rolling of each section of the work shall commence immediately after the application of the aggregate thereto and shall continue until the aggregate is firmly embedded in the binder to the satisfaction of Council. Where required by Council to ensure an even distribution of aggregate, the surface shall be traversed with a light drag broom.

If after the initial rolling, the broom has any tendency to dislodge aggregate particles bedded in the binder, Council may direct that the drag brooming be deferred or eliminated and that light hand brooming be substituted. The drag broom shall be in accordance with Section 9.6 of this Specification. Rolling shall be continued as long as possible and for up to 24 hours.

When the aggregate contains moisture, and weather conditions are suitable for drying, Council may direct that rolling of the spread aggregate be deferred for a short time to permit the moisture to evaporate. If the aggregate does not become dry shortly after it is spread, and Council considers that the adhesion of the binder to the aggregate is unsatisfactory, Council may direct that the work cease until the conditions improve sufficiently.

9.16 TOLERANCES ON FINISHED SURFACE OF PAVEMENT MATERIAL

The tolerances on the level of the finished surface of pavement (neglecting the thickness bituminous surface treatment) measured at the time of preparation for surface treatment shall be as follows:

- (a) Finished level at any point - minus 15 mm plus 12 mm;
- (b) Grading in any direction in 3-metres or less - minus 12 mm plus 6 mm; and
- (c) Grading in any direction in more than 3-metres - minus 12 mm per 3 metres, plus 6 mm per 3-metres.

The tolerances in lateral position shall be as follows:

- (a) Edge of bitumen surface (where not in contact with concrete gutter) - 75 mm plus or minus.
- (b) Width of seal (where not in contact with concrete gutter) - minus 75 mm plus 150 mm.
- (c) Width of pavement (where not in contact with concrete gutter) - minus 75 mm plus 150 mm.

In the event of the tolerances being exceeded the Council may at their absolute discretion, order the Supervisor to carry out any reconstruction or remedial measures considered to be necessary or desirable.

9.17 DEFECTIVE WORK OR MATERIALS

The Supervisor shall remove from the work and shall bear the cost of replacing any binder which has been overheated, or has deteriorated, or become contaminated in any way, prior to its application to the road.

The Supervisor shall make good, at the developer's expense, any work which in the opinion of Council, is not in accordance with this specification, whether caused by bad workmanship or defective materials supplied by the Supervisor, or by materials made defective by the Supervisor's operations.

9.18 WASTE MATERIALS

Waste aggregate, bitumen, empty containers or other materials remaining after completion of the work shall be disposed of by the Supervisor to the satisfaction of Council and the work shall be left in a neat and tidy condition. All costs associated with disposal of waste material shall be borne by the developer.

9.19 MAINTENANCE

Excess surplus aggregate shall be removed from the pavement no later than 5-days after surfacing.

Should any defect occur in the surface during the Maintenance Period, the area affected shall be thoroughly cleaned and treated with binder and aggregate as specified herein.

SECTION 10 - SUPPLYING AND LAYING ASPHALTIC CONCRETE

10.1 DESCRIPTION

This specification provides for the supply and spreading of asphaltic concrete on new and existing road pavements in base (or corrective) course, intermediate course and/or wearing course for the areas, depths and nominal mix sizes indicated on the Engineering Plans.

10.2 ASPHALTIC CONCRETE DESIGN

Asphaltic concrete wearing surface designs shall be prepared by a suitably qualified Civil or Geotechnical Engineer as part of the formal pavement design specified in Section 2.5.3 of Council's Engineering Design Specification and Section 7.2 of this Specification. The wearing surface in these designs will be assumed to provide no structural strength.

The minimum surfacing requirement for flexible road pavements in residential and industrial areas shall be a single coat flush seal with a 50 mm thick asphaltic concrete (AC10) surface applied in two 25 mm thick layers, over the whole of the road pavement, in accordance with Section 2.5.3 of Council's Engineering Design Specification.

Except in the case of roundabouts, the placement of the final minimum 25 mm layer of AC10 will generally be delayed for a period of 12-months or until the majority of dwellings have been erected within the subdivision. Should it not be practicable to provide the final layer, the Supervisor will be required to lodge a bond with Council in accordance with Section 1.26.2 of this Specification.

Prior to laying of asphaltic concrete a single coat bituminous seal of 10 mm aggregate shall be constructed in accordance with Section 9 of this Specification.

In rural areas a single coat spray bituminous seal incorporating 20 mm and 14 mm aggregate will be required in lieu of the 50 mm AC10 specified above.

10.3 QUALITY OF MATERIALS

10.3.1 Mineral Aggregates

Aggregates shall comply with the requirements of AS2758.5 'Asphalt Aggregates' and RTA Specification R116 'Asphalt (Dense Graded and Open Graded)'.

10.3.2 Mineral Filler

The mineral filler shall comply with AS2357 'Mineral Fillers for Asphalt'.

10.3.3 Binder

The binder shall be bitumen complying with the requirements of AS2008 'Residual Bitumen for Pavements' and RTA Specification 3253 'Bitumen for Pavements'.

10.3.4 Additives

Polymer modified binder shall comply with the AUSTRROADS Specification for 'Polymer Modified

Binders (APRG Report No.19)'.

10.4 PROPORTIONING OF MIXES

Each mix shall be designed as shown on the Engineering Plans and shall be in accordance with Council's Engineering Design Specification. The bitumen content, stability, voids in the mix, and the percentage of voids in the mineral aggregate filled by binder shall generally be in accordance with AS2150 'Hot Mix Asphalt - A Guide to Good Practice' and the requirements of this Section of the Specification. The mix shall be designed to ensure as low permeability as practicable.

10.4.1 Departures from Job Mix

The grading of the mix as delivered shall not be varied from the grading of the job mix by more than the tolerances set out in Table 10.1 when tested in accordance with AS2891.3 'Methods of Sampling and Testing Asphalt - Bitumen Content and Aggregate Grading'.

Table 10.1 Percentage Bitumen by Mass of Total Mix

SIEVE SIZE	PERMISSIBLE VARIATION BY MASS OF TOTAL AGGREGATE
19.0 mm and larger	plus or minus 10.0%
4.75 mm and larger	plus or minus 7.0%
2.36 mm and 1.18 mm	plus or minus 5.0%
600um and 300um	plus or minus 4.0%
150um	plus or minus 2.5%
75um	plus or minus 1.5%

Some increase in bitumen content may be required for aggregate with high absorption characteristics to compensate for the bitumen absorption. The bitumen content of the mix produced shall not be more than 0.3% below the nominated bitumen content of the job mix without Council's approval.

10.4.2 Stability of Mixes

The minimum stability of the compacted job mix shall be 4kN as determined by the Marshall Method (at 35 blows) in accordance with AS2150 'Hot Mix Asphalt - A Guide to Good Practice'.

Mixes with actual stability below 4kN shall be removed from the site and replaced with an approved mix at the developers expense.

10.4.3 Voids in Compacted Mixes

The minimum percentage of air voids in the total compacted mix shall be generally between 3% and 7% as determined in accordance with AS2150 'Hot Mix Asphalt - A Guide to Good Practice'.

Compacted mixes with actual percentage of voids of below the lower limit or above the upper limit shall be removed from the site.

10.4.4 Voids Filled By Binder

The design or job mixes shall be such that a minimum of 65% to 80% of the air voids in the total mineral aggregate will be filled by the binder when determined in accordance with AS2150 'Hot Mix Asphalt - A Guide to Good Practice'.

10.5 MIXING PROCEDURE

Mixing shall be undertaken in an approved batch pug mill, continuous pug mill or drum mixing plant, capable of uniformly mixing coarse and fine aggregate, filler and binder to meet the specified requirements at all times.

The plant shall include a rotary drum dryer for the continuous heating and drying of the coarse and fine aggregate. Each size of mineral material comprising the coarse and fine aggregates shall be fed into the dryer by mechanical feeder at a uniform rate. The dryer shall maintain a uniform flow of aggregate at correct temperature sufficient to operate the mixing unit at its rated output. Filler shall be stored and handled in a separate system from that which handles aggregate and be capable of accurately measuring and adding the quantity required. The bitumen storage and handling shall be arranged so that contamination of the bitumen by flushing liquids or other materials cannot occur.

10.5.1 Batch or Continuous Pug Mill Plants

Batch pug mill and continuous pug mill type plants shall include a gradation control unit for screening the hot aggregates into a minimum of four sizes, to be stored in separate bins generally containing particles 40 mm to 20 mm, 20 mm to 10 mm, 10 mm to 3 mm and minus 3 mm. Screening shall be such that there is substantial freedom from segregation in each bin and from carry over of particles into the wrong bin.

Batch pug mill plants shall measure by mass the requisite batch quantity of material from each hot aggregate bin and filler bin. The accuracy of the measurements shall be within plus or minus 1% of the indicated mass in each case. The required batch quantity of bitumen shall be measured by mass or volume and the accuracy of measurement shall be within plus or minus 1% of the indicated batch quantity.

In the case of continuous pug mill plants, the flow from each hot aggregate storage bin, the filler bin and the binder supply shall be accurately synchronised.

10.5.2 Drum Mixing Plants

In the case of drum mixing plants, aggregate shall be proportioned and measured by accurately calibrated, variable speed continuous belt feeders from each cold storage bin. Each feeder shall maintain a constant and uniform flow throughout the range of its calibration and shall be equipped with a warning device to indicate any interruption to material flow. The plant shall have positive interlocking between the flows of aggregates, filler and bitumen and to prevent contact between the burner flame and the bitumen.

10.5.3 Temperatures

Thermometer elements of a suitable type, shall be placed in the flow of material from the dryer and in the binder, storage tank or supply line. Thermometer registrations shall be readable and accurate within plus or minus 2%.

Bitumen shall be at a temperature not exceeding 165°C when introduced to the mix.

Aggregates shall be heated to such a temperature that, when filler and binder are added, the temperature of the mixed asphaltic concrete shall not exceed 165°C.

The mix shall leave the pug mill, drum and/or the hot storage bins at a temperature between 140°C and 165°C. In no circumstances shall the temperature of the mix at the time of laying be less than the minimum value specified in Section 10.9.3 of this Specification for the appropriate road surface temperature and layer thickness.

10.5.4 Mixing Time

Mixing time shall be such that all particles of mineral aggregate are uniformly coated with binder.

10.5.5 Storage of Mix

Asphaltic concrete may be stored in an insulated storage bin prior to delivery. The storage bin shall be constructed and operated in a manner that minimises segregation and avoids localised overheating. Asphaltic concrete which has been stored for more than 24-hours or is below the minimum temperature specified in Section 10.9.3 of this Specification shall not be used.

10.5.6 Testing and Acceptance of Mix

Council reserves the right to require the Supervisor to organise testing of the mix as delivered at any time to determine its compliance with the specification. The Supervisor shall be responsible for taking the samples and shall supply all facilities, equipment and labour for that purpose. The samples shall be taken by the Supervisor under the supervision of Council and tested in accordance with AS2891.3.1 'Bitumen Content and Aggregate Grading - Reflux Method'. The Supervisor shall arrange testing of the sample by an approved NATA Registered Laboratory and shall provide the results to Council.

10.6 TRANSPORT

The asphaltic concrete shall be discharged into trucks, the bodies of which shall be kept thoroughly cleaned and coated with a thin film of a suitable release agent to prevent mix sticking to the body of the truck. Care is to be taken to remove surplus release agent before loading.

During transport the asphaltic concrete shall be covered with a canvas or other suitable cover which is securely held down.

When asphaltic concrete is to be transported over long distances or in cold conditions, the asphaltic concrete shall be covered with a heavy duty canvas or similar waterproof cover which overlaps the sides of the truck body by at least 250 mm and is tied down securely.

Delivery of the mix shall be at a uniform rate within the capacity of the spreading and compacting equipment. Transport shall be as expeditious as possible to minimise cooling of the asphaltic concrete.

10.7 PREPARATION OF PAVEMENT

The pavement shall be dry and shall be thoroughly broomed before other work is undertaken. Any foreign matter adhering to the pavement and not swept off by the broom shall be removed by other means. Council may direct that existing bituminous surfaced pavements be hosed or otherwise washed to remove all superficial foreign matter. Any areas significantly affected by oil contamination shall be cleaned by an approved method.

Under no circumstances shall swept or waste material be placed on the footpath verge at any time.

Any depressions or uneven areas are to be tack coated and brought up to the general level of the pavement with asphaltic concrete before the main course is laid. The correction course shall be laid, jointed and compacted in accordance with Section 10.9, 10.10 and 10.11 of this Specification to the general level of the existing surface.

10.8 TACK COAT

Unless otherwise directed by Council, the whole of the area to be sheeted with asphaltic concrete shall be lightly and evenly coated with rapid setting bitumen emulsion (cationic preferred) which shall meet the requirements of RTA Specification 305 'Supply and Delivery of Bitumen Emulsion' and 3254 'Bitumen Emulsion'. The application rate of residual bitumen shall be 0.15 to 0.30-litres per square metre.

For bitumen emulsion complying with RTA Specification 305 and 3254, the application rate of undiluted bitumen emulsion shall be between 0.25 and 0.50-litres per square metre. If the bitumen emulsion is diluted, the application rate shall be adjusted to obtain the undiluted rate.

The tack coat shall be allowed to 'break' (water separating from the bitumen) and resist picking up by tyres before the asphaltic concrete is laid. Over application of tack coat, due to existing surface depression, shall be removed or dispersed by brushing.

The bitumen emulsion shall be applied by a mechanical sprayer with spray bar, unless the areas to be spared are small, irregular or inaccessible to mechanical sprayers, in which case application by hand spraying or brushing may be permitted.

All contact surfaces of gutters or other structures and all joints shall be painted with a thin uniform application of tack coat.

Care shall be taken to ensure that bitumen emulsion is not sprayed on, or allowed to coat any concrete kerbing adjacent to the pavement. Any material so sprayed shall be removed as directed by Council. The Supervisor shall be held responsible for any damage to adjacent property, vehicles or persons sprayed with tack coating material. When trucks or other vehicles are likely to move from tack coated areas onto adjacent finished surfaces, the finished surfaces shall be blinded with limestone dust or similar material to protect them from bituminous material carried over on truck tyres.

10.9 SPREADING

10.9.1 Paver

Spreading shall be by an approved self propelled paving machine, having an effective spreading capacity of not less than 50-tonnes of mix per hour and shall be capable of laying the asphaltic concrete to a true and even finish.

10.9.2 Paving Procedures

Before commencing paving operations the work shall be set out with the order of runs, position of joints and levels clearly defined.

The paver shall operate at a uniform speed and its output shall match the rate of delivery of asphaltic concrete such that, as far as practicable, continuous spreading of the mix is achieved.

The paver shall be operated so that material does not accumulate along the sides of the receiving

hopper. Any mix in or under the paver, which has become cool due to delay in the transport of mix or for any other reason shall be removed and replaced at the developers expense.

In the event of faulty operation of the paver causing irregularities in the spread material, work shall be suspended until the fault is rectified. If the irregularities are of a minor nature, and the surface has not cooled below 115°C it will be permissible to spread a thin layer of fresh mix by hand, level it with lutes and roll immediately. Should this treatment fail to produce a surface of acceptable texture and regularity, or if the faults left by the spreader are of appreciable depth, then the defective surface shall be removed and fresh material shall be laid as previously described.

Unless otherwise approved by Council, asphaltic concrete shall not be spread by hand behind the paver. Workers shall not stand or walk on hot asphaltic concrete except where necessary for correction of the surface.

Council may approve spreading asphaltic concrete by hand for the correction of minor irregularities and in areas inaccessible to mechanical pavers. Asphaltic concrete, so placed, shall be spread so as to produce a smooth even surface with uniform density to the correct level.

10.9.3 Laying Temperature

The temperature of asphaltic concrete at the time of laying shall be as shown in Table 10.3 below.

Table 10.2 Laying Temperature of Asphaltic Concrete

ROAD SURFACE TEMPERATURE IN SHADE °C	MIX LAYING TEMPERATURES °C			
	Layer Thickness Less Than 30 mm	Layer Thickness 30 mm to 40 mm	Layer Thickness 45 mm to 100 mm	Layer Thickness Over 100 mm
5-10	Not Permitted	150 ⁽¹⁾	145 ⁽¹⁾	130-155
10-15	150 ⁽¹⁾	145 ⁽¹⁾	140 ⁽¹⁾	125-150
15-25	145 ⁽¹⁾	140 ⁽¹⁾	135 ⁽¹⁾	120-145
Over 25	140 ⁽¹⁾	135 ⁽¹⁾	130 ⁽¹⁾	115-140

(1) Minimum laying temperature

Under no circumstances will AC be allowed to be laid where the pavement temperature is less than 5°C or when the surface of the road is wet.

The temperature of the mix shall be measured in the truck just prior to discharging into the power hopper. A suitable stem type thermometer readable and accurate to within 2°C with a range from at least 0°C to 200°C shall be used. The stem shall be inserted into the mix to a depth of approximately 200 mm at a location of about 300 mm from the side of the truck body. An average of at least two (2) readings shall be adopted as a temperature of the mix. The results of the mix temperature measurements recorded when taking delivery shall be made available for Council inspection at all times.

Council may reject that part of any truck load or any part of the compacted works which in Council’s opinion contains cooled asphaltic concrete which is liable to affect the quality of the finished surface.

10.9.4 Layer Thickness

The minimum compacted thickness of mix shall be as specified on the Engineering Plans and shall be in accordance with Section 10.2 of this Specification. In all cases the minimum compacted thickness of the mix shall be a minimum of 2.5-times and a maximum of 4-times the aggregate size.

10.10 JOINTS

Work is to be so arranged as to keep the number of joints, both longitudinal and transverse to a minimum.

The density and surface finish at joints shall be similar to those of the remainder of the layer.

10.10.1 Longitudinal Joints

Care shall be taken to provide positive bond between adjoining runs.

Longitudinal joints shall be continuous and parallel and shall coincide within 150 mm with lines of change of crossfall where such occur. Joints in successive layers shall be offset by at least 150 mm. Joints shall be located away from traffic wheel tracks. Work shall be arranged to avoid longitudinal joint faces being left exposed overnight.

Hot joints shall be constructed by leaving an uncompacted strip approximately 150 mm wide along the edge of the first run, and after the adjoining run has been spread, both sides of the joint shall be rolled simultaneously.

In the case of cold longitudinal joints, the edge of the first run shall be butted and slightly elevated while hot using hand lutes. If the edge is left exposed overnight or longer, Council may direct that the edge be trimmed to straight vertical face by cutting disc, rotary saw or pneumatic space and lightly coated with tack coat material by brushing. The adjoining run shall be placed against the prepared edge with an overlap of 25 mm to 50 mm. The overlap shall be pushed back using lutes, immediately after placing, to form a slight ridge along the joint which the roller shall compress adjacent to the edge of the previously placed run. Any excess, overlapping or segregated material shall be discarded and not incorporated in the mat.

The compaction of the mix at a longitudinal joint shall be carried out immediately behind the paver using either a static steel wheeled roller or a vibratory steel wheeled roller operated in a static mode. Compaction shall commence with the roller travelling on the cold lane with a 150 mm overlap on the hot lane for the first forward and reverse pass. The second pass shall be made on the hot lane with 150 mm overlap on the cold lane.

When thin layers are to be compacted, Council may allow the use of a vibratory steel wheeled roller operated in the vibratory mode. In this instance, the first forward and reverse pass shall be made with the roller travelling on the hot lane and with a 150 mm overlap on the cold lane.

Rolling shall continue until the joint is smooth and dense.

10.10.2 Transverse Joints

When the end of the spread material has cooled due to disruption of the work, or when resuming work on the next day, a transverse joint shall be formed.

Transverse joints shall be approximately at right angles to the direction of paving. They shall be staggered by at least 1.0-metre between successive layers and between adjacent runs.

Runs shall be ended either against a timber bulkhead to ensure a straight vertical, well compacted edge or by feathering out and compacting. In the latter case, the feathered material shall be cut back to a line where the full thickness exists. The surface shape of the end of the run shall be checked by a straight edge to locate the line of cut.

The end of the previous run shall be lightly tack coated before the paving of the next run proceeds.

At the start of the run, care shall be taken to set the screed level with sufficient allowance for

compaction so that just the correct thickness of asphaltic concrete is placed. The screed shall be heated to the mix temperature.

The joint shall be rolled with a steel roller transversely for several passes, with the roller projecting about 150 mm further onto the fresh mix in each pass. If a vibratory roller is used, it shall be operated in the static mode. At locations where it is difficult to roll the joint transversely, Council may direct that an alternative procedure be used.

Boards shall be used for off pavement movement of the roller to prevent rounding the edge of the mat. The joint shall then be rolled longitudinally.

When the asphaltic concrete layer is required to join and match the level of an existing pavement surface, sufficient of the existing material shall be cut out to achieve the minimum specified layer thickness.

10.11 COMPACTION

10.11.1 Plant and Equipment

Compaction equipment shall be self propelled and various combinations may be used.

- (a) Static steel rollers shall have a mass not less than 8-tonnes and a drum loading not less than 35 kN per metre width of drum. Tandem rollers are preferred but three wheeled rollers may be used;
- (b) Vibratory rollers shall have a mass not less than 6-tonnes and a drum loading not less than 20 kN per metre width of drum. Tandem, articulated rollers with vibration on both drums are preferred. They should be capable of vibration frequencies between 30 Hz and 50 Hz and amplitudes between 0.4 mm and 1.0 mm. They shall have provision for the vibration to be cut off when the roller is coming to a halt or changing direction;
- (c) Pneumatic rollers shall have a mass of 10-tonnes to 20-tonnes ballasted and tyre inflation pressures variable up to 700 kPa. Numbers of wheels may vary from seven (7) to eleven (11). The tyres shall have wide, flat smooth rolling surfaces.

The minimum number of rollers used for compaction of asphaltic concrete laid at various rates shall be as shown in Table 10.4.

Table 10.3 Minimum Number of Rollers for Compaction of Asphaltic Concrete

OUTPUT		ALTERNATIVE COMBINATIONS		
Tonnes/Hour	Tonnes/Day	Steel Static	Steel Vibrating	Pneumatic Tyred
Up to 45	Up to 360	1	-	1
		-	1	-
45 to 85	360 to 680	1	-	2
		-	1	1
85 to 120	680 to 960	1	-	3
		2	-	2
		-	2	1

The output ranges are to be used as a guide only. Extra rollers may be needed in case of breakdown.

For compaction of confined areas or patching works a small vibrating roller, or hand operated

vibrating compactor acceptable to Council shall be used.

10.11.2 Compaction Procedures

Rollers shall travel at a uniform speed not exceeding 5 km/h for steel rollers and 10 km/hr for vibratory steel and pneumatic tyred rollers. They shall not remain stationary on recently compacted mix.

Lateral changes in the direction of rolling shall be made on previously compacted mix. Sharp turns shall be avoided and any changes from forward to reverse shall be made smoothly. Vibratory rollers shall not be stopped or reverse while in the vibrating mode.

Vibratory steel rollers shall not be permitted to travel when operating in the vibratory mode on cement concrete or previously compacted asphaltic concrete except where specified in Section 10.10 of this Specification.

Compaction shall be considered in three (3) stages, initial, secondary and final rolling:

(a) Initial rolling;

Initial rolling shall be carried out using steel rollers. Vibrating steel rollers may be used, but they shall be operated in the static mode for the initial passes. On deep lift asphaltic concrete, pneumatic tyred rollers may be used. When compacting thin layers, Council may permit vibratory steel rollers to be operated initially in the vibratory mode.

Initial rolling shall commence as soon as possible after laying has commenced. Rollers shall be operated as close as possible to the paver, without damaging the mat, with their driving wheels closest to the paver except on very steep grades where the rollers shall operate with their driving wheels on the partially compacted mix.

When rolling unsupported edges, rollers shall overhand the edge by not more than 100 mm.

When the layer thickness is 100 mm or more, rolling to within 200 mm of an unsupported edge shall be delayed to minimise possible displacement of the asphaltic concrete. When compacting this 200 mm wide strip, the first pass shall cover about half the width of the unrolled strip; the second pass shall cover the remainder of the width but shall not overhang the edge by more than 100 mm.

The transverse and longitudinal joints and edges shall be compacted first as specified in Section 10.10 of this Specification. Rolling shall then proceed longitudinally with the roller moving parallel to the run and reversing along the same track.

The roller shall gradually progress from the lower to the higher edge of the new mat. Each tract shall overlap the preceding one by about 150 mm and shall terminate beyond the end of the preceding track by at least 1-metre.

Initial rolling shall be completed before the mix temperature falls below 105°C.

(b) Secondary Rolling;

Secondary rolling shall immediately follow initial rolling. Either vibratory steel rollers, static steel rollers or pneumatic tyred rollers shall be used. The tyre pressures of pneumatic typed rollers shall be between 500 kPa and 600 kPa. Rolling shall commence at the longitudinal joint side of the run, with the roller reversing along the same track on each pass and shifting across the run in full roller widths to the opposite site.

Secondary rolling shall be completed before the mix temperature falls below 80°C.

(c) Final Rolling

Final rolling shall be carried out by a pneumatic tyred roller with tyre pressures between 600 kPa and 700 kPa to eliminate all roller marks and to produce a uniform finish. If any tyre marks exist after final rolling, Council may direct that they be removed with a steel roller operated in a static mode.

If secondary rolling has been carried out with a pneumatic tyred roller, a steel roller may be used for final rolling.

Final rolling shall be completed before the mix temperature falls below 60°C.

10.11.3 Testing and Acceptance of the Compacted Surface

The minimum Characteristic Value of Relative Compaction of a finished asphaltic concrete wearing surface when tested in accordance with RTA Specification 612 and AS2891 'Methods of Sampling and Testing Asphalt', shall be 95% for a layer of thickness than 50 mm or 96% for a layer of thickness of 50 mm or greater. It is the Supervisors responsibility to organise compaction testing on the completed asphalt works. All testing shall be undertaken by an approved NATA Registered Laboratory and all test results shall be provided to Council prior to commencement of the next stage of works. All costs associated with compaction testing shall be borne by the developer.

Compaction testing cannot be undertaken on layer thickness < 30 mm

Mix with an actual Characteristic Value of Relative Compaction of less than 90% shall be removed from the site and replaced with an approved mix in accordance at the developers expense. Any section of the work required to be removed and replaced shall be retested as specified above.

Note:

Characteristic Value = Mean Value – ks, where k is a constant and s is the standard deviation.

10.12 TOLERANCES ON FINISHED SURFACE OF PAVEMENT

The finished surfaces shall be smooth, dense and true to shape. Sufficient measurements of thickness shall be taken before and after compacting to establish the relationship between the thickness of the uncompacted material and the completed work. The thickness shall then be controlled by measurements taken of the uncompacted material immediately behind the paver. When the measurements indicate that an area will not be within the allowable tolerances for the completed work, the uncompacted area shall be corrected while the material is still in a workable condition by adding or loosening and removing material. Otherwise the defective area shall be removed and replaced with fresh material. Irregularities exceed the tolerances given above in a particular course shall be corrected before a subsequent course is placed.

Notwithstanding the above requirements, the tolerances on the finished surface level at any point of the various courses shall be in accordance with the following:

- (a) For grading in any direction in 3-metres or less:
 - (i) Corrective Course - minus 10 mm, plus 10 mm; and
 - (ii) Wearing Course – minus 5 mm, plus 5 mm.
- (b) Grading in any direction in more than 3-metres:
 - (i) Corrective Course – minus 5 mm per 3-metres, plus 5 mm per 3-metres; and
 - (ii) Wearing Course – minus 5 mm per 3-metres, plus 5 mm per 3-metres.

On vertical curves similar standards shall apply with an allowance made for the vertical curvature.

The Supervisor shall remain responsible for laying the minimum specified layer thickness of asphaltic concrete on all areas of the pavement.

The finished surface shall be lightly sprinkled with limestone dust, or other approved filler, in quantity only sufficient to ensure the mix will not be tacky under traffic.

10.13 CLEANING OF GUTTERS AND GULLY PITS

All gutters and gully pits located within the boundaries of the work shall be cleaned and kept clean during the period of contract, of all sit debris, rubbish and surplus asphaltic concrete arising out of the execution of the works.

10.14 MAINTENANCE

The pavement shall be maintained after completion for the specified period and should any failure of the asphaltic concrete wearing course occur during this period, the area affected shall be removed and be replaced with similar material to that used on the work. Gutters and gully pits shall be cleaned of all asphaltic concrete debris at the end of the Maintenance Period if necessary.\

SECTION 11 - EROSION AND SEDIMENT CONTROL

11.1 DESCRIPTION

This specification provides for erosion and sediment control measures to be undertaken during construction. The measures to be provided shall be in accordance with approved Erosion and Sediment Control Plans or Soil and Water Management Plans prepared in accordance with Section 4.1 of Councils Engineering Design Specification and the current edition of 'Managing Urban Stormwater, Soils and Construction'. In cases where the above documents are in conflict, the current edition of 'Managing Urban Stormwater, Soils and Construction' shall take precedence.

The range of measures provided below are in no way exhaustive and should not be considered to reflect the full range of available erosion and sediment controls. Reference should be made to the current edition of 'Managing Urban Stormwater, Soils and Construction' for additional details and measures.

The Supervisor shall provide and maintain controls where shown on the Engineering Plans or where directed by Council. Such controls shall be in accordance with this Specification.

11.2 GENERAL

Perimeter control measures shall be placed prior to or in conjunction with the first phase of earthworks. Construction shall be phased if directed by Council so that land disturbance is confined to areas of workable size. This will limit the duration for which disturbed areas are exposed to erosion. Stabilisation measures shall be applied on the first disturbed section before the next section is opened up.

Topsoil stockpiles shall be located outside hazard areas such as drainage depressions in accordance with Section 4.3 of this Specification.

Where site regrading or filling is being undertaken, the provisions of Section 3.3 of this Specification relating to redirecting surface water away from the face of batters shall be complied with.

All areas not subject to construction works shall be retained free from disturbance or damage the currency of the work. Should these area become disturbed or damaged they shall be reinstated by the Supervisor.

11.3 SEDIMENT AND EROSION CONTROL DEVICES

Where shown on the Engineering Plans or otherwise specified, sediment and erosion control devices shall be constructed and maintained. Unless the device is a permanent structure, it shall be removed when the areas above it have been stabilised. The control devices shall be constructed in the locations shown on the Engineering Plans unless an alternative location is directed by Council.

11.3.1 Temporary Construction Exit

The temporary construction exit is provided to shake off site material from existing vehicles and shall consist of a pad of coarse crushed rock, crushed slag or gravel (25 mm to 75 mm range) having a minimum depth of 200 mm, a minimum length of 15-metre and a width as nominated on the Engineering Plans.

The performance of the constructed pad will be assessed by the Principal Certifying Authority.

Further refinement of the pad may be required to achieve adequate sediment control.

11.3.2 Diversion Channels/Banks

Diversion channels are earth channels with a minor ridge on their lower side constructed across the slope. The channel shall have side slopes not steeper than 1(V):3(H).

Where flows are too large to be contained by a simple channel, a diversion bank shall be constructed below the channel. The bank shall have a compacted height of at least 500 mm with batter slopes no greater than 1(V):3(H) and a top width of 600 mm. The channel behind the bank shall fall to the outlet point.

Diversions shall be stabilised by the method nominated on the Engineering Plans or otherwise specified and shall be located where directed by Council so that runoff will discharge onto stable disposal areas without causing erosion.

11.3.3 Level Spreader

Level spreaders shall be used as outlets for diversion channels or at other areas of concentrated flow of runoff where conversion to sheet flows onto stable areas is required. The level spreader shall be excavated at zero grade, the length shall be as shown on the Engineering Plans or otherwise specified. The approach grade of the diversion channel shall not exceed 1% for at least 6-metres before it enters the spreader.

The Supervisor shall pay particular attention to the sill to ensure that it remains stable and vigorous vegetative cover is maintained below it.

The channel behind the sill shall be de silted when directed by Council.

11.3.4 Straw Bale Barrier

The straw bale barrier shall consist of wire bound bales laid lengthwise in an excavated trench nominally 100 mm deep. Each bale shall be securely anchored by two (2) stakes or star pickets driven through its centre into the ground such that the top of the stake or star picket is level with the top of the bale. The barrier shall be constructed on that part of the perimeter of the site or at other locations within the site as shown on the Engineering Plans or where directed by Council.

11.3.5 Gravel Outlet

The gravel outlet, which is an auxiliary structure, shall be installed in conjunction with and as part of a diversion bank or other structure designed to temporarily pond sediment laden surface runoff.

Aggregate shall be in the 50 mm to 75 mm size range. The crest of the outlet shall be a minimum of 150 mm lower than the top of the associated earth bank and may be either level or slightly concave. The gravel outlet shall otherwise have a similar cross section to that of the adjacent earth bank. The length shall be as shown on the Engineering Plans or otherwise specified.

11.3.6 Sediment Traps

Temporary de silting structures shall be constructed at inlets to stormwater systems to trap sediment in runoff. They shall consist of the following types:

- (a) Surface Inlet

The surface inlet pit shall be completed to throat level and then topped off with on or more courses of standard masonry construction blocks, nominal 150 mm thickness, laid on side. Aggregate in the 50 mm to 75 mm size range shall be banked around the outside of the blocks.

(b) Kerb Inlet

Kerb inlet traps shall be provided to pits in areas of high erosion susceptibility and shall be constructed by modifying the kerb inlet to allow sediment filtration. A roll or wire netting of a nominal 150 mm diameter filled with aggregate in the 10, 14, 20, 50 or 75 mm size range shall be placed across the throat. The netting shall be lapped approximately 150 mm and wired together. At both ends a concrete spacer block laid on side shall be placed normal to the kerb.

(c) Culverts

Existing road embankments with culverts beneath shall be converted to temporary sediment traps by building around the entrance to the culvert a box of unmortared standard masonry construction blocks nominal 150 mm thickness, placed on side. A filter of gravel or coarse aggregate (50 mm to 75 mm size range) shall be placed against the modified inlet. The filter material shall batter at 1(H):3(V) from the top of the blockwork. The width and height of the blockwork shall be as specified.

11.3.7 Filter Dams

Filter dams built of pervious materials such as straw bales, washed aggregate or gravel, gabions, or sandbags filled with aggregate or gravel shall be placed across minor drainage channels while ground cover is being established, to steady flow velocity and to trap sediment. In grassed channels they shall be embedded at least 100 mm in the soil to prevent water tunnelling beneath them.

Straw bales shall be securely anchored by driving two (2) stakes or star pickets through the centre of each bale into the ground such that the top of the stake or star picket is level with the top of the bale.

Aggregate or gravel filled sandbags shall be stacked in an interlocking fashion.

The Supervisor shall check the dam after each storm for structural damage or clogging by silt and other debris and make prompt repairs or replacements to the satisfaction of Council.

11.3.8 Sediment Basins

Sediment basins are required to intercept sediment laden runoff from all sites where the disturbed area exceeds 2000-square metres and is not covered with topsoil or sub base material such as crushed sandstone within 14-days of disturbance. Sediment basins do not replace other on site controls such as silt fences, diversion drains, sediment traps at stormwater inlets and temporary revegetation works.

The size of the sediment basin will depend upon the nature of the site subgrade and will generally be detailed on an approved Erosion and Sediment Control Plan, prepared in accordance with Section 4.1 of Councils Engineering Design Specification, and sized to contain all of the runoff from the disturbed area for storms between 33% AEP and 20% AEP depending on the site. In the absence of any approved basin designs a minimum volume of 160-cubic metres per hectare of disturbed catchment shall be provided.

All sediment basins shall be regularly maintained to ensure that water has been drained from them prior to the next storm. Prior to discharge it will be necessary to dose the basin with gypsum to achieve a turbidity of less than 150 NTU. This is to be undertaken within 48-hours of each storm.

Local experience suggests that a minimum of 50 kg of gypsum per 100-cubic metres of water is required in the first instance. Subsequent doses may be reduced due to the residual effect of gypsum

in the basin.

Council's Engineer must inspect the treated water prior to discharge, if necessary samples will be taken for testing.

Sediment basins generally should be drained within 72-hours of the conclusion of a storm.

11.4 DUST CONTROL

The Supervisor shall take all reasonable steps to limit the creation of any dust nuisance and control the surface and airborne movement of dust, which might arise during the execution of the Works.

During dry weather, active development sites can produce 'dust' due to the unstabilised nature of the excavated surface, stockpiling of building materials and associated activities. To minimise this dust the Supervisor shall regularly water all haul roads, access tracks and construction areas, or stabilise these areas by other approved means. Caution should be used to ensure that excessive watering does not produce runoff.

Any machinery/tools used onsite that have the potential to create dust must be fitted with dust arresters and/or collection containers where applicable.

Council may direct that work cease until such time as any particular dust nuisance has been controlled satisfactorily.

Water may be extracted from permanent storage areas located within sediment basins for dust control measures. The extraction of water from sediment basins is conditioned on the water available and the sediments suspended at the time of extraction. Consideration should be given to the dispersiveness of the existing soils onsite and the storage depth of the sediment basin so as not to disperse settled sediments.

Flocculation of the sediment basin may be required to avoid damage to water extraction equipment due to suspended sediments.

11.5 STOCKPILE PROTECTION

Effective stockpiling of "stripped" topsoil, excavated material and other bulk building materials to be utilised in construction is required. The effectiveness of any stockpile is in its location, accessibility and protection.

Stockpiles such as soil, sand, blue metal and landscape supplies must be kept watered, thereby minimising dust generation. In addition, silt fences may be installed to assist in containing and separating stockpiles.

Plastic sheeting or membrane must not be used as it prevents the absorption of water by the stockpile and concentrates surface water flow. Wind and sunlight also affect plastic, accelerating its disintegration.

The selection of suitable stockpile locations should consider the following:

- (a) Vehicular accessibility;
- (b) Avoidance of any concentrated stormwater flow paths;
- (c) Remain clear of site activities;
- (d) Erection of safety barricading to isolate stockpiles of solid materials such as reinforcement steel, concrete formwork, scaffolding etc.;
- (e) Large stockpiles or restrictive sites may result in the use of multiple, smaller stockpiles;

- (f) Not impede the drip zone of any tree; and
- (g) Be suitable for the installation and maintenance of erosion and sediment control devices.

Material handling devices such as pallets must be stored within the site whilst awaiting collection. They are not to be placed in the public way at any time.

Details of all proposed stockpiles must be included in the Erosion and Sediment Control Plan.

11.6 REVEGETATION

Footpath reserves, embankments, public reserves and open channels shall be grassed.

The method and type of grassing shall be submitted to the Council for approval.

The site preparation, fertilising, sowing, turfing, watering, mowing and general caring of the grass shall generally be in accordance with this Specification and the current edition of 'Managing Urban Stormwater, Soils and Construction'. To protect the grass during initial stages, a geotextile fabric may be used. The installation of the fabric shall be as per the manufacturer's specification.

11.7 MAINTENANCE

All sediment and erosion control devices shall be maintained in a satisfactory working order throughout the works or until such time as the area above has been stabilised and Council directs that the device be removed.

The Supervisor shall inspect the devices after each storm for structural damage or clogging by silt and other debris and make prompt repairs or replacement.

In the case of the temporary construction exit, the Supervisor shall undertake weekly surface cleaning by drag broom or equivalent, to remove all build up of foreign material to the satisfaction of Council.

To control bank growth and to maintain healthy ground cover in channels and on banks, mowing shall be undertaken as directed by Council.

11.8 STABILISATION OF DISTURBED AREAS

Stabilisation of disturbed areas shall be generally in accordance with Section 12 of this Specification. All sealed areas shall be watered twice weekly until grass is established or covered with bitumen straw mulch at the following rates:

- (a) Mulch – 0.5 kg/m²; and
- (b) Bitumen Emulsion – 0.25-litres per square metre (50% water, 50% slow breaking anionic emulsion mixture).

Where surface slopes exceed 1(V):6(H) bitumen straw mulch shall be applied after seeding at the above rates.

Unless otherwise directed by Council, the following principles shall be applied for the control of erosion and sedimentation:

- (a) Stabilisation of denuded areas shall commence within 60-days of the areas being disturbed.
- (b) Stabilisation of the area over all stormwater drainage lines and sewer mains not within road reservations shall commence within 15-days of backfilling.

- (c) All temporary earth diversion channels/banks and sediment basin embankments shall be seeded within 15-days of completion of their earthworks.
- (d) Stabilisation of all cut and fill slopes shall be commenced within 15-days of completion of formation.
- (e) All stabilisation measures shall be undertaken prior to final approval of works.

SECTION 12 - REVEGETATION

12.1 DESCRIPTION

This Specification provides for the preparation, fertilising, sowing, turfing, watering, mowing and generally caring for grasses on defined areas so as to provide thereon a dense uniformly distributed cover of the various varieties of grasses specified.

12.2 PREPARATION

Areas to be revegetated shall be ripped on the contour to a depth of 200 mm prior to topsoiling to provide a key for the topsoil and improve infiltration of water, unless otherwise directed by Council. Following ripping, the areas shall be topsoiled in accordance with the provisions of the Section 2 of this Specification.

If considered necessary by Council, the area to be revegetated shall be ploughed with an approved rotary hoe or other agricultural machinery. Ploughing shall not exceed the topsoil depths and generally shall be carried out on the contour to a depth of 100 mm.

On steep slopes and on other areas of high erosion hazard a rough surface shall be developed. A fine tilth shall be acceptable only on areas of low slope which are not subject to a high erosion hazard.

Light grading to affect the required surface profile may also be necessary and shall be carried out by the Supervisor if so directed by Council.

Council may direct that the topsoil or areas to be revegetated by turfing be firmed with a light roller.

All weeds and the roots of all noxious weeds shall be thoroughly cleared from the site. Trees existing on the site shall not be disturbed other than by being trimmed as directed.

12.3 SEEDING

12.3.1 Grass Seed

The seed used shall be of the best quality available, shall have good germination characteristics and be true to variety. The seed shall be obtained from reputable seed merchants and the Supervisor shall produce satisfactory evidence that these requirements have been complied with. Until used, any seed in the possession of the Supervisor shall be stored off the ground in a cool, dry place and shall not be stored any longer than possible before being used.

12.3.2 Seed Mixture for Reserves, Median Strips and Embankments

(a) Spring/Summer Mix;

Lolium perenne (Perennial Rye)	60 kg/ha ⁽¹⁾
Cyclodon dactylon (Couch) – Irrigation Hulled	30 kg/ha
Axonotus affanus (Carpet Grass)	30 kg/ha ⁽¹⁾
Trifolium (O'Connells Sub Clover)	3 kg/ha
Festuca Rubra (fine Fescue)	27 kg/ha
TOTAL	105 kg/ha

(1) For drought conditions substitute Tall Fescue (15 kg/ha) for Perennial Rye (7.5 kg/ha) and Carpet Grass (7.5 kg/ha).

(b) Autumn Winter Mix;

Lolium perenne (Perennial Rye)	90 kg/ha
Festuca rubra (fine Fescue)	30 kg/ha
Agrostis tenuis (Bent)	7.5 kg/ha
Festuca arundinacea (Demeter Fescue)	22.5 kg/ha
TOTAL	150 kg/ha

12.3.3 Seed Mixture for Earth Drainage Channels

The following mixture of seed shall be used on inverts and batters of drainage channels and inlet and outlet drains:

(a) Spring/Summer Mix;

Lolium perenne (Perennial Rye)	60 kg/ha
Festuca arundinacea (Demeter Fescue)	45 kg/ha
Cyclodon dactylon (Couch) Irrigation Hulled	15 kg/ha
Axonotus affanus (Carpet Grass)	15 kg/ha
Trifolium repens (White Clover)	3 kg/ha
Trifolium (O'Connells Sub Clover)	4.5 kg/ha
Echinochloa frumentacea (Japanese millet)	7.5 kg/ha
TOTAL	150 kg/ha

(b) Autumn/Winter Mix;

Lolium perenne (Perennial Rye)	90 kg/ha
Festuca arundinacea (Demeter Fescue)	30 kg/ha
Puccinellia Distans (Saltol)	15 kg/ha
Trifolium repens (White Clover)	3 kg/ha
Trifolium (O'Connells Sub Clover)	4.5 kg/ha
Secale cereale (Ryecorn)	7.5 kg/ha
TOTAL	150 kg/ha

12.3.4 Fertilisers

The fertiliser to be used shall be an approved Nitrogen, Phosphoric Acid, and Potash compound starter fertiliser. Unless otherwise specified, the rate of application of fertiliser shall be in accordance with the following:

- (a) For footways, median strips, embankments and reserves - 200 kg/ha
- (b) For drainage channels - 250 kg/ha.

Where clay panning is evident or where hard packing river loams are used, then Council may direct that Gypsum be spread at the rate of 200-500 kg/ha.

12.3.5 Sowing

When the area to be sown has been brought to a condition suitable for the sowing of grass seed the seeding mixture shall be proportioned in accordance with the requirements of Section 12.3.2 or Section 12.3.3 of this Specification.

After proportioning, the various quantities of seeds shall be thoroughly mixed so that each variety will be uniformly distributed throughout the whole.

The seed mixture then shall be uniformly distributed at the prescribed rate of application per hectare and unless otherwise specified, the prescribed quantity per hectare of fertiliser shall be distributed at the same time.

After sowing by hydroseeding or by conventional methods in accordance with Section 12.3.6 and Section 12.3.7 of this Specification respectively, the whole of the area shall be uniformly watered. The volume of water to be applied at this time shall be equivalent to 10 mm of rain unless weather conditions dictate otherwise, in which case Council shall determine the volume of water to be applied.

The Supervisor shall take care to avoid the formation of rills in the surface by a too rapid application of the water.

If Council is of the opinions that excessive rilling has occurred in the surface, from whatever cause, Council shall have the right to direct the Supervisor to re-prepare and re-sow the affected area, and if so directed, the Supervisor shall re-prepare and re-sow the area, at the developer's expense all to the satisfaction of Council.

Sowing shall be carried out by the method indicated on the Engineering Plans or otherwise specified, in accordance with the provisions of Section 12.3.6 or Section 12.3.7 of this Specification.

12.3.6 Hydroseeding

When sowing is to be carried out by hydroseeding, a hydromulching machine approved by Council shall be used to mix and spray a slurry of seed mixture, fertiliser, mulch and water onto the area to be grassed. Sufficient mulch material shall be contained in the slurry to carry and stick the seed mixture and fertiliser to the prepared surface.

The mulch shall be wood pulp unless otherwise specified or approved by Council.

12.3.7 Conventional Sowing and Mulching with Bitumen

When sowing is to be carried out by conventional methods the seed and fertiliser may be distributed uniformly by means of mechanical seed sower to be followed by an application of bitumen emulsion.

No area shall be sown with seed whilst it is in such a softened state due to excessive moisture that it cannot support the weight of the loaded bitumen sprayer which is proposed to be used for the application of bitumen emulsion to the area.

The seeds shall be covered by 5 mm of soil by means of rolling or other methods acceptable to Council.

As soon as practicable after the application of the water in accordance with Section 12.3.5 of this Specification, the area shall be sprayed with bitumen emulsion by means of an approved power sprayer fitted with a fixed spray bar set at the maximum width per row.

An approved solution of slow breaking anionic bitumen emulsion and water mixed in the ratio of 1:1 shall be used for this purpose. The application rate shall be 1-litre per square metre for general work and 4.0-litres per square metre for drainage channels subject to concentrated water flows.

In areas where it is impracticable to utilise the fixed spray bar of the sprayer, the bitumen emulsion may be applied by means of an approved hand spray attached to the power sprayer.

Any areas deformed and/or rutted in contravention of this restriction shall be repaired and re-sown by the Supervisor to the satisfaction of Council. All costs associated with such works shall be borne by the developer.

12.4 TURFING

12.4.1 Fertiliser

When the area has been prepared in accordance with Section 12.2 of this Specification, the whole area shall be watered and fertilised by the application of an approved Nitrogen, Phosphoric Acid, and Potash compound fertiliser with an analysis of 10:3.6:6.2 respectively. The fertiliser shall be applied at the rate of 200 kg per hectare spread evenly over the surface, lightly raked and re watered.

12.4.2 Supply and Planting of Sods

The sods are to be of couch grass unless otherwise specified. They are to be of even thickness are to be green throughout when delivered to site. The area from which the supply of grass is to be obtained is to be mowed before the sods are cut.

The placing of the sods shall be commenced immediately the soil has been watered and fertilised.

On completion of the laying of the sods, they are to be compacted by watering and rolling with a 100 kg to 150 kg roller. Each sod should be butted against the previously laid sod and no gaps shall remain between the sods after laying.

Sites too steep for this compaction treatment shall be covered with a locating mesh of a type approved by Council.

Immediately after the sods have been rolled, approved topsoil shall be spread to a depth of 10 mm over the whole area and thoroughly watered.

12.5 CARE OF REVEGETATED AREAS

The Supervisor shall regularly care for the sown and turfed areas and shall do all things necessary to assist the growth of the revegetated areas. The Supervisor shall regularly maintain the moisture content of the ground at a level sufficient to allow, where applicable, proper germination of the seed to take place, to assist the rooting of the runners and generally to encourage the subsequent growth of

the grasses.

This regular care by the Supervisor shall be continued throughout the currency of the work plus the maintenance period.

Two (2) months after the sowing of the grass seeds and three to four weeks after laying turf, the Supervisor shall make an application of Sulphate of Ammonia at the rate of 250 kg per hectare which shall be well watered into the soil.

Council may direct the Supervisor to defer this second application of fertiliser to a later date if Council is of the opinion that the grass growth would benefit by such deferment. If so directed, the Supervisor shall defer the application of the fertiliser until the date nominated by Council.

12.6 MOWING

From time to time during the currency of the contract the Supervisor shall mow the grassed area with an approved power grass mower. The height of cut shall be nominated by Council and the Supervisor shall obtain Council's direction in this matter before commencing mowing operations.

If Council so directs, the Supervisor shall mow the grass within 48-hours of being so directed.

12.7 ESTABLISHMENT

A uniformly distributed dense grass cover of the specified varieties of grass shall be established over the whole of the area specified to be grassed so as to eliminate wind and water erosion of the surface.

The Supervisor shall take all steps necessary to establish such dense grass cover over the whole of the area to be grassed. The Supervisor's obligations will not be regarded as being fully discharged until such time as the required dense grass cover has been established over the whole of the relevant area to the satisfaction of Council.

12.8 MAINTENANCE

The Supervisor shall maintain the grass cover established until all the other works specified have been satisfactorily completed and final approval is given.

If necessary, the Supervisor shall take all action necessary to re-establish areas of grass damaged or destroyed by adverse weather conditions, fire, floodwaters, vandalism or any other cause. All costs associated with such actions shall be borne by the developer.

The Supervisor shall be responsible for any damage that may be caused to any finished surfaces, fences, or paved areas by plant or trucks used during the progress of the work.

SECTION 13 - POST CONSTRUCTION

13.1 WORK AS EXECUTED DRAWINGS

Following the completion of engineering works in a subdivision or development, the Supervisor is required to arrange a 'Works-as-Executed' (WAE) plan to be prepared by a Registered Surveyor and forwarded to Council prior to the issue of the Subdivision Certificate.

The Supervisor shall provide WAE plans in the following formats:

- (a) One (1) hard copy on transparent film with hanging strips attached to the right hand side of each sheet (Rodia suspension strips Reference 311 or equivalent eight (8) hole suspension hanging strips);
- (b) An electronic format to be advised by Council.

The Surveyor shall certify on the plan that all works have been executed to the requirements and specifications of Council, including that pipes have been laid within the easements provided and that the easements for batter and support are a minimum of 1.0-metre clear of the line of the cutting or the toe of the filling.

The plan shall show the new levels of any additional work which has been carried out such as subsoil drains, service conduits, stub mains, interallotment lines, etc.

On the longitudinal section above the design centreline levels shall be shown the levels of the centrelines as constructed. On each cross section above the design levels shall be shown the level as constructed of the road centreline, top of kerb, each edge of concrete path paving and the footway level at the road boundary. The distance from the road centreline to the face of the kerb shall also be shown. Kerb return developments shall show the 'as constructed' level above each design level shown. Pipeline longitudinal sections shall show the 'as executed' invert levels of each pipe at each pit as well as any alterations to the plan.

All 'as executed' levels, additions and alterations shall be shown in red to AHD.

Notwithstanding the above requirements 'Works-as-Executed' plans shall include the following:

- (a) Copies of all Engineering Plans with notation that all works have been completed in accordance with the approved plans and specification;
- (b) Any departure from the approved plan including changes in pipe detail, filling, kerb alignment, boundaries, road pavements and road pavement base, and subbase thickness;
- (c) Any additional work that has been undertaken, including design CBR and design ESA's;
- (d) The location of conduits, subsoil drains and rises, stub mains and inter-allotment drainage lines and inlet points and stormwater drainage manholes etc;
- (e) WAE levels of pipeline long sections showing the constructed invert levels of each pipe each pit lid level, pit lid and lintel type and size, pit type and size and each pipe dimension;
- (f) The surveyed location of all pits, pipework and GPT's for installation to Council assets mapping system.
- (g) Certification by the Registered Surveyor responsible for the linen plan of survey covering the subdivision that all stormwater pipes, including inter-allotment drains and associated pits and drainage structures are located and constructed within the respective easements;
- (h) The 5% AEP, 1% AEP and PMF flood lines for all development as they applies to the site;
- (i) A nominated floor height to AHD for all lots that are not greater than 600 mm above the 1% AEP level;

- (j) Fill Plan supported by a suitably accredited 'Subdivisional Geotech' engineers Report certifying the extent, depth of fill and degree of compaction for all areas where the depth of fill exceeds 300mm. Lot classification in accordance with AS2870 'Residential Slabs and Footings' is required prior to the issue of the Subdivision Certificate;
- (k) Street names as shown on the plan of subdivision;
- (l) All other details which have a bearing on the extent of works and their acceptance by Council;
- (m) State survey marks with MGA co-ordinates and levels to AHD that have been used as part of the works;
- (n) The following certificate is to be appended to the cover sheet of the plans and signed by a Registered Surveyor;

"I hereby certify that;

- (i) All construction works have been carried out in accordance with the approved engineering drawings and Council Specification with regard to location and level as shown in ink hereon or has been varied as shown in ink hereon.
- (ii) All construction within private land has appropriate easement, right of carriageway or restriction-as-to-user rights over the whole of the construction.
- (iii) All pipes, pits drainage structures and detention facilities lay within their relative easements.

NAME: _____

SIGNATURE: _____

DATE: _____

Registered Surveyor

13.2 INSPECTION AND TESTING

Following the completion of engineering works in a subdivision or development, the Supervisor is required to compile and forward a copy of all inspection and tests undertaken as part the works to Council prior to the release of the linen plan of subdivision.

13.3 MAINTENANCE MANUALS

Following the completion of engineering works in a subdivision or development, the Supervisor is required to arrange a maintenance manual for all stormwater drainage structures, except pipes and pits, to be prepared by a qualified Consultant and forwarded to Council prior to the release of the linen plan of subdivision.

13.4 ASSETS REGISTER

Following the completion of engineering works in a subdivision or development, the Supervisor is required to register all assets to be handed over to Council within Councils Asset Register prior to the release of the linen plan of subdivision. The asset registration is to be in electronic format and in the template available from Council..

APPENDIX D – STANDARD DRAWINGS