



Civil Services Specification

REVISION

Revision	Date	Comment	Prepared By	Approved By

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1 EARTHWORKS

1.1 GENERAL

1.1.1 Extent of Contract

This specification is for the carrying out of all earthworks indicated on the drawings. It is the Contractor's responsibility to assess the nature of the soil being cut or filled and to select plant which will achieve the specified results. The Contractor shall also make his own assessment of the quantities of earthworks to be carried out, including the accuracy of existing contours and any effect on the levels of the in-situ material due to the operations selected by the Contractor.

1.1.2 Contours and Levels

The accuracy of the existing spot levels shown on the drawings is $\pm 100\text{mm}$. The contours define the surface between the spot levels to an accuracy of half the displayed contour intervals as advised by the Licensed Surveyor. If it can be demonstrated by the Contractor within 14 days of the date of possession of the site that the existing levels differ from the levels shown on the drawings by more than this, the Contract Sum shall be adjusted accordingly.

1.1.3 Standards

Earthworks shall be completed in accordance with:

- AS 3798-2007 Guidelines on Earthworks for Commercial and Residential Developments
- AS 1289 Methods of Testing Soils for Engineering Purposes
- AS 2870-2011 Residential Slabs and Footings – Construction
- AS 1726-1993 Geotechnical Site Investigations.

1.1.4 Existing Services

The Contractor shall familiarise himself and all personnel on Site, under his direction, with the location of all existing services on and adjacent to the Site and he shall be responsible for the cost of repairing any damage caused to existing services. This repair work shall be carried out by the relevant Authority and shall be arranged by the Contractor.

1.1.5 Disturbance to Private Properties

The Contractor shall not cause any damage to, and shall take reasonable precautions to avoid excessive disturbance to any private property due to dust, vibration, noise, etc., resulting from these works. The Contractor shall not enter onto private property without the written consent of the land owner.

1.1.6 Natural or Existing Vegetation

In areas not requiring earthworks, access for machines shall not be permitted. Any unauthorised disturbance shall be remediated to the full satisfaction of the Local Authority or relevant government department (ie Department of Environment and Conservation or Federal Environment Department) and all costs borne by the Contractor.

1.2 MATERIALS

1.2.1 Structural Fill

Structural fill shall be clean granular material, with maximum particle size of 2.36mm as defined in AS 1289 Grading Chart Figure C6.1.1 and shall have the following properties:

- (i) Plasticity index equal to 0% (ie non-plastic) for fractions finer than 0.075mm.
- (ii) Clean, cohesionless, free draining and free of all silty, organic or any other deleterious inclusions.
- (iii) Contain no more than 5% (by weight) of fractions finer than 0.075mm.



- (iv) The ratio of maximum to minimum density shall be greater than 1:20. The maximum and minimum densities shall be determined in accordance with test AS1289 5.5.1.
- (v) A minimum permeability of 10-4 m/s.

The Contractor shall provide test results from a NATA registered testing authority which demonstrate compliance with the above criteria prior to undertaking filling operations.

1.2.2 General Fill

General fill shall be clean granular material with maximum particle size of 37.5mm as defined in AS 1289 Grading chart figure C6.1.1 and shall have the following properties.

- (i) Plasticity index equal to 0% (ie non-plastic) for fractions finer than 0.075mm.
- (ii) Clean, cohesionless, free draining and free of all silty, organic or any other deleterious inclusions.

1.2.3 Limestone Fill

Limestone fill is that material won from cut areas which consists of limestone of medium to high rock strength and which may contain secondary ion solution features such as cap rock, root chemicals, pinnacles and vughs. This fill may include sand in varying proportions.

After application of ripping, crushing and rolling by heavy steel machines, the limestone fill shall include a wide range of particle sizes up to a maximum stone size of 250mm.

1.3 QUALITY ASSURANCE - EARTHWORKS

The Contractor shall produce, and submit weekly to the Superintendent, verified records to confirm that the specification requirements have been achieved as follows:

Item	Test/Record	Frequency
(i) Topsoil stripping	Contractor's Certificate	1 per project
(ii) Finished Earthworks levels	Surveyed as-constructed drawing showing finished contours	1 per project
(iii) Compaction - bulk fill	Compaction Certificate	1 per Lot, but not less than 1 per 500m ²
(iv) Compaction – method specification	Contractor's Certificate confirming roller, passes, water used	For each layer on a grid agreed with Superintendent.
NB. Compaction tests should be adequately distributed so as to give a good representation of the whole area, including additional testing within 2 metres of corners and edges of earthworked area.		
(v) Stabilisation Hydromulch/Gluon 240):		
- Mix details	Supplier's Certificate	1 per mix
- Application rate	Supplier's Certificate	1 per project

1.4 CLEARING

The clearing shall consist of removal from the area designated in the drawings of all trees, standing or fallen, and other vegetation, boulders and rubbish and shall include the grubbing out of all stumps and tree roots to a depth of 600mm below the natural surface or 400mm below the finished cut surface, whichever is the lower, and disposing of all spoils resulting from the clearing and grubbing. Any holes left after grubbing shall be filled and compacted to the same density as that of the surrounding undisturbed soil.

As little as possible of the surface soil shall be removed during clearing operations.

The Contractor shall take precautions to minimise damage to growing trees and shrubs, fences and other improvements outside the designated areas, and any damage shall be made good.

The spoils of all clearing and grubbing operations shall be removed from the Site. No spoils of clearing and grubbing shall be pushed beyond the limits of the site, or burnt.

Clearing must be approved by the Superintendent prior to further earthworks being commenced.

1.5 STRIPPING OF TOPSOIL

The existing topsoil shall be stripped from all areas to be earthworked, prior to the commencement of the earthworks, and stockpiled on site.

Topsoil is defined as the layer of surface material containing humus, roots, plants and organic material exceeding one percent by weight.

1.6 CUTTING TO DESIGN LEVELS

Following the removal of topsoil, areas shown to be cut shall be cut to achieve the levels shown on the drawings.

Any areas which are over excavated shall be refilled to the design levels shown on the drawings. Any refilling shall be placed as specified in "Filling to Design Levels".

Where no fill is to be applied, cut surfaces shall be finished by proof rolling.

1.7 FILLING TO DESIGN LEVELS (STRUCTURAL AND GENERAL FILL)

Structural fill shall be used in the following situations:

- backfill to walls and other constructed works such as pipes, access chambers etc.
- refill to over excavated areas
- refill to over excavated rock areas
- within 600mm of the finished surface level for any areas of lot fill.

General fill or limestone fill may be placed in all other areas. For limestone fill requirements, see the following section.

Fill material shall be placed in layers not exceeding 500mm thick which shall be varied to suit the material being placed and the method of compaction.

The Contractor shall assess the fill quantities required within the earthworks area and allow to import any shortfall of fill. All associated costs shall be included in the lump sum tender.

Each layer of fill material shall be compacted to achieve a minimum density ratio of 95% as obtained in test AS 1289.5.4.1 with maximum dry density determined in accordance with AS 1289.5.2.1 (modified compactive effort).

1.8 EARTHWORKS - COHESIVE SOILS

The Contractor is to have any material, which is proposed to be re-utilised in trenches or earthworked areas, tested to determine characteristics to allow compaction to achieve a minimum density ratio of 95% as obtained in test AS 1289.5.4.1 with the MMDD determined in accordance with AS 1289.5.2.1 (modified compactive effort).

The Contractor is to ensure that these materials are placed in layers and at a moisture content as directed by the Geotechnical Consultant to achieve the desired compaction.

1.9 FILLING TO DESIGN LEVELS (LIMESTONE FILL)

1.9.1 Foundation Preparation

The exposed foundation shall be compacted with five (5) passes of a vibrating roller with a static mass of not less than 10 tonnes and a centrifugal force of not less than 150 kN in the frequency range of 20 to 30 Hertz. Rolling speed shall not exceed 7km/hr. Each roller pass shall overlap the previous pass by not less than 10%.

The foundation shall be watered at a rate of not less than 15 L/sq.m during compaction.

1.9.2 Fill Placement and Compaction

Fill material shall be placed in approximately horizontal layers not exceeding 300mm in thickness. Sufficient sand shall be blended with the limestone such that the compacted material does not contain any significant voids.

Water shall be applied during the compaction process at a rate of not less than 10 L/sq.m for each 100mm of layer thickness.

Each layer shall be compacted with not less than 8 passes of a vibrating pad foot roller with a static mass of not less than 10 tonne and a centrifugal force of not less than 150 kN in the frequency range of 20 to 30 Hertz. Rolling speed shall not exceed 7 km/hr. Each roller pass shall overlap the previous pass by not less than 10%.

1.10 EXCESS SPOIL

Whereafter the completion of earthworks there is excess spoil it shall be placed on site if shown on the drawings or otherwise removed from the site at the Contractor's expense.

1.11 TOPSOIL

1.11.1 Re-spreading Topsoil

The topsoil for resspreading shall be assessed and blended on site to comprise not more than 20 percent by weight of vegetable and humus material, not more than 20 percent below the 75 micron sieve size and a maximum soil particle size of 50mm. The topsoil shall be free of vegetation pieces larger than 200mm in any one direction. Topsoil shall be spread uniformly to a thickness not less than 50mm and not more than 100mm. Excess topsoil shall be removed from site at the Contractor's expense.

1.12 TOLERANCES

The completed earthworks levels shall be within plus 100mm or minus 0mm of the design levels without retaining walls shown on the drawings. Where retaining walls exist or will exist in the future, the earthworks tolerance shall be within plus 50mm or minus 0mm of the design levels shown on the drawings. The design levels are the levels on the completed earthworks including respread topsoil.

1.13 TESTING

Earthworks shall be progressively tested to demonstrate that the specified relative compaction has been achieved.

Field density testing shall be completed and certified by an independent NATA registered laboratory. The laboratory shall calibrate field density testing apparatus against laboratory tests. Field density tests may consist of sand replacement to AS 1289.5.3.1, nuclear density tests to AS 1289.5.8.4 to 5.8.9 and Perth Sand Penetrometer to AS 1289.6.3.3.

For structural fill in which the maximum particle size is 2.36mm, to achieve a density index of 65%, testing may be by Perth Sand Penetrometer to achieve a resistance as determined by the NATA testing laboratory, but not less than 7 blows over a test interval of 150mm to 450mm and 9 blows over the test interval of 450mm to 750mm below fill level.

General fill shall be tested by means of sand replacement or nuclear density tests.

The frequency of testing shall be as listed in the clause "Quality Assurance - Earthworks" of this specification. The results of all tests shall be recorded on the appropriate forms as included in this specification.

1.14 EARTHWORKS AS-CONSTRUCTED INFORMATION

On the completion of the following stages of earthworks the Contractor shall provide a detailed survey pick-up of as-constructed levels over the earthworked area:

- over excavation surface levels (on top of rock) prior to the placement of structural fill, and

- on the finished earthworked surface level.

Practical completion will not be granted until this information has been provided to the satisfaction of the Superintendent.

1.15 STABILISATION

1.15.1 Stabilisation by Topsoil and Seeding

Surface stabilisation shall be carried out with a minimum 50mm and maximum 100mm layer of topsoil, and by hydromulching with seed any disturbed areas as specified in the drawings. Where the Contractor has insufficient topsoil to achieve this minimum topsoil thickness the Contractor shall obtain the Superintendent's direction before proceeding further.

1.16 FINISH

All finished surfaces shall be graded to the finished presentation stage prior to hydromulching, including:

- rolling the finished earthworks prior to topsoil spreading
- evenly graded changes between design levels and contours
- all wheel tracks and other disturbances levelled out
- removal of all debris or rock pieces greater than 100mm in any direction from the surface
- removal of all spoil heaps
- rolling or smudge boarding the finished topsoil surface.

2 STORMWATER DRAINAGE

2.1 GENERAL

All the Works shall be constructed in accordance with the drawings and this Specification and will be subject to inspections and approval of the relevant Local Authority.

Any instructions from the Authority pertaining to the works shall be issued by that Authority to the Superintendent.

2.2 QUALITY ASSURANCE – DRAINAGE

The Contractor shall produce and submit weekly to the Superintendent verified records to confirm that the specification requirements have been achieved as follows:

Item as Specified	Test/Record	Frequency
Materials Specification	<ul style="list-style-type: none"> • Supplier's Certificate 	1 per delivery
Drain set-out	<ul style="list-style-type: none"> • Contractor's Survey record 	1 per drain line
Drain Construction	<ul style="list-style-type: none"> • Survey as-constructed details (as per standard form - see Appendix 2) • Invert levels • Access chamber locations Access chamber cover levels Bedding details • Gully locations • Gully type/level Pipe size/type 	1 per drain line
Backfill	<ul style="list-style-type: none"> • Contractor's Certificate • Sand for 300mm above top of pipe and under pavement 	1 per drain line
Compaction	<ul style="list-style-type: none"> • Compaction Certificate (as per standard form – See Appendix 2) 	3 tests per drain line per layer

The contractor shall note on the record where any item fails to meet the specified requirements, including the

planned remedial action to be taken.

2.3 TOLERANCES

Grades steeper than 1:500	$\pm 10\%$ of design grade and $\pm 20\text{mm}$ of design invert level
Grades flatter than 1:500	up to 10% steeper, but not less than 5% flatter than design grade and $\pm 10\text{mm}$ of design invert levels

2.4 MATERIALS

2.4.1 Australian Standards

All workmanship and materials used in the Works shall conform to the current Australian Standard where such Standard exists. Where such Standard does not exist, the current Authority's Standard shall apply.

2.4.2 Concrete Pipes (RC)

All concrete pipes shall conform to AS 4058 and subsequent Amendments and shall be spigot and socket rubber ring joint type, unless otherwise specified or authorised by the Superintendent. Strength shall be "Class 2" unless otherwise noted on the drawings.

2.4.3 PVC Pipes

Rigid PVC drainage pipes and fittings shall be class stormwater HD with solvent cement type joints, manufactured in accordance with AS 1254.

2.4.4 Concrete

Concrete shall conform to AS 3600 and shall be supplied by a concrete supplier conforming with AS 1379. Concrete shall have a characteristic strength of N20, 60mm slump and maximum aggregate size of 20mm. Concrete strength shall be tested by means of product assessment methods in accordance with Section 20.4 of AS 3600. The Contractor shall register the project and arrange for results to be sent to the Superintendent.

On site mixing of concrete may be used subject to the Contractor's proposal of mix details being submitted to, and approved by the Superintendent. Site mixed concrete shall be subjected to site testing for slump and strength in accordance with the relevant Australian Standards.

2.4.5 Cement

All cement used shall be Portland Cement in accordance with AS 3972 and obtained from an approved manufacturer.

Cement shall be delivered to the site fresh and in sealed bags and there stored in a weatherproof shed until such time that it is to be used. Any bag showing sign of deterioration or setting shall be rejected.

2.4.6 Aggregate

Fine aggregate shall be well graded, clean, sharp and free from clay and organic impurities in accordance with AS 1141.

Coarse aggregate shall be crushed granite or diorite clean and free from all impurities and dust in accordance with AS 1141.

The maximum particle size shall not exceed 20mm.

2.4.7 Water

Water for use in concrete and mortar shall be of potable quality, free from any impurities harmful to concrete, mortar or steel.

2.4.8 Sand



Sand for mortar will be crushed stone or natural sand in accordance with AS 2701.4-2001.

Sand for bedding or backfilling shall be clean sand or fine gravel as defined by AS 1289 grading chart figure C6.1.1. It shall be free from roots, clay or any deleterious matter and shall have a maximum nominal particle size of 4.75mm.

2.4.9 Steel

Steel reinforcing fabric and steel reinforcing bars for concrete shall comply with the requirements of AS 1302, AS 1303 and AS 1304 and be free from loose rust or matter likely to impair the bond with concrete.

Structural steel shall comply with the requirements of AS 4100.

2.5 SETTING OUT

2.5.1 General

The drawings show centre lines, grades, lengths, diameters, invert levels at entry and exit of drains and the location of access chambers.

The distances shown between access chambers are mostly scaled measurements and are for the Contractor's guidance only. In all instances access chambers are to be constructed in the locations shown. Centre lines and invert levels are to be strictly adhered to and no alterations shall be made except on the written authority of the Superintendent.

2.5.2 Setting out of Drainage Lines

Centre lines and profile levels for fixing invert levels shall be set out by an Engineering Surveyor, arranged for by the Contractor at his expense.

Profiles shall be set such that there are never less than 3 profiles between access chamber locations or between an access chamber and a headwall or endwall.

2.5.3 Pegging of Access Chambers, Headwalls and Endwalls

Each access chamber is to be pegged and levelled by the Contractor's Engineering Surveyor.

The centre of each access chamber shall be pegged and at least two reference stakes at 5 metres offset on either side of the access chamber centreline shall be provided.

The Contractor's Engineering Surveyor shall provide the Contractor's Foreman with a copy of his survey record for each drain. The record shall indicate all reference pegs, offset pegs, RLs of dumpy pegs, access chamber to access chamber distance, distance to house connections (where applicable) and the height of boning rods. Records shall be retained by the Foreman on Site and shall be available for inspection by the Superintendent.

2.6 EXCAVATION

2.6.1 General

Tenderers must form their own opinion, and take what tests on Site they consider necessary to ascertain what is the nature of the ground, sub-surface strata and ground water levels.

Clearing, topsoil and stabilisation shall be carried out in accordance with the Earthworks section of this specification.

2.6.2 Dewatering

The Contractor shall allow within his Tender the cost of all dewatering and any additional construction costs due to wet ground conditions.

In the event of water being encountered, the Contractor shall make adequate provision to ensure that the excavation is kept free from water during the process of concrete pouring and for a period of at least 24 hours after the concrete pour. No bedding or pipes shall be laid in water and trenches are to be kept free from water

until refill is commenced.

2.6.3 Trench Excavation

Trenches are to be cut to line and gradient. The line of cut for each side of the trench shall be marked out on the surface before excavation commences.

The trench widths shall be kept to a minimum consistent with the bed width requirements and the requirements of adequate working space and timbering.

Tunnelling shall be only carried out where directed by the Superintendent, and the Contractor shall submit details of method prior to commencement for the approval of the Superintendent.

Should the bed of the trench be over excavated, then the over-excavated volume shall be replaced in accordance with the Earthworks section of this specification.

All trench excavation shall be made in a safe manner, the trenches either being shored or battered back to achieve this. The Contractor shall comply with the Construction Safety section of this specification.

Trenches shall be kept free from water, debris and falling earth.

The final trimming of the bottom 150mm of trench excavation must not be carried out until immediately prior to concreting or placing of pipe bedding. Excavation must be completed for a minimum of 10 metres length ahead of pipe laying.

2.6.4 Access Chamber Excavation

Excavation for access chambers must be made to the correct depth and of sufficient dimensions to allow the base and walls to be constructed.

The Contractor shall be responsible for safety at all times.

2.6.5 Blasting

Blasting shall be only carried out with the approval of the Superintendent and prior to any blasting, the Superintendent and the Contractor shall inspect all necessary safety precautions. Handling, safety precautions and storage of explosives shall be in accordance with the requirements of the Mines Regulation Act 1946, the Explosives and Dangerous Goods Act 1961, AS 2187 Part 1 1984 and AS 2187 Part 2, Rules for the Storage and Handling of Explosives, AS 2188, Magazines for Handling of Explosives and such other precautions as the Superintendent may require.

Blasting shall only be carried out by a person holding a current W.A. Mines Department Shot Firer's Permit.

2.6.6 Excavation in Roadways, Footpaths etc.

Excavation is to be kept to a minimum in existing roadways, footpaths and other paved areas, ensuring that damage to such structures is kept to a minimum. The Local Authority shall be notified and that Authority's approval received prior to commencing work in roadways and footpaths.

2.6.7 Measurement of Excavation

Measurement of excavation for the purpose of costing variations shall be in accordance with the minimum trench dimensions shown on the drawings, and measurement shall comply with AS 1181 "Method of Measurement of Civil Engineering Works."

2.6.8 Obstruction to Traffic

Excavation material shall be deposited in an area causing the least interference to vehicular and pedestrian traffic.

At all times when the works are left unattended, all excavation in public areas shall be fenced off with warning signs and lighting and the Contractor shall ensure that they remain in a safe condition.



These safety precautions shall be subject to the approval of the Superintendent.

2.7 DRAIN CONSTRUCTION

2.7.1 Pipe Setting

All pipes shall be set in a straight line between access chambers or between access chambers and headwalls. On inspection by the Superintendent, any pipe not placed in a straight line shall be replaced at the cost of the Contractor.

Pipes shall be set in an upstream direction unless otherwise approved by the Superintendent.

2.7.2 RC Concrete Pipe Jointing

Spigot and socket pipes shall be jointed with the spigot fully home in the socket and rubber ring joint. Pipes shall be laid such that the sockets face upstream.

2.7.3 PVC Pipe Jointing

PVC pipes shall be jointed with the spigot fully home in the socket and the joint solvent cemented. The solvent cement used shall be the product recommended by the pipe manufacturer. The solvent cement shall be applied using a clean brush to both surfaces of the joint after these surfaces have been cleaned.

2.7.4 Pipe Bedding

Pipes shall be bedded on a clean sand bedding. Pipes constructed in dry sand conditions shall be bedded on a shaped trench base. Pipes constructed in wet ground conditions shall be bedded on a crushed rock bedding, all in accordance with the drawings.

Perforated sub-soil drainage pipes shall be bedded on a 10mm all in filter aggregate.

2.7.5 Timber Piling and Keel

Where the trench base is insecure, the Superintendent shall direct the Contractor to construct the drainage line, access chamber or entry pit on timber piles and keel. The Contractor shall bear the cost of all piling and keel required.

Timber pile and keel for pipes less than 460mm diameter shall consist of one line of piles with continuous 250 x 50 Jarrah keel with wedges. For pipes over 460mm diameter, piles shall be in pairs with cross bearer, 2 sets per pipe, as shown on the drawings.

Piles shall consist of 100mm x 100mm Jarrah and be driven into undisturbed ground until the maximum set from 14 blows of a 32 Kg dolly free falling 1.0 metre does not exceed 25mm.

Access chamber and entry pit bases on insecure ground shall be supported on three 125mm x 50mm Jarrah bearers with 125mm x 38mm Jarrah decking supported by nine timber piles.

2.8 ACCESS CHAMBERS

Access chambers shall be bedded on sand compacted in accordance with the Earthworks section of this specification.

Access chambers shall be constructed on a precast or cast insitu concrete base. The pit shall consist of precast reinforced concrete well liners with interlocking joints and brickwork as shown on the drawings. Covers shall be circular as shown on the drawings.

Where a access chamber is located in a road pavement area, the access chamber shall be covered with a heavy duty circular cast iron framed cover cast in a precast circular concrete surround.

2.9 GULLY ENTRY PITS

Gully type entry pits shall be constructed as specified for drainage access chambers except that the concrete

cover shall contain a cast-in grate and frame.

The grates and surrounds shall be fabricated as shown on the detail drawings. The grate must be hinged in the frame.

2.10 SIDE ENTRY PIT

Side entry pits shall be constructed as shown on the detail drawings.

A precast reinforced concrete "Wembley Cement Industries" or similar approved conversion slab with deflection vanes shall be installed on the pit to suit the road gutter level. The entry direction of the vanes shall be the same as the direction of gutter flow.

2.11 STEP IRONS

Where access chamber or entry pits exceed 1.0 metres in depth, measured from top of cover to invert level of the base, step irons shall be provided at 300mm centres for the full depth of the access chamber as detailed on the drawings.

2.12 HEADWALLS AND ENDWALLS

These are to be constructed using either concrete with 20 MPa 28 day cylinder test compressive strength or mortared stonework as detailed on the drawings.

For mortared stonework the size and quality of the stone shall be as specified for Stone Pitching.

2.13 STONE PITCHING

Stones shall generally weigh in excess of 10 Kg each and the greatest dimension of any stone shall not exceed 1.5 times its least dimension.

Stones shall be hard, sound and durable, shall be set on a sand bed in a close fitting pattern and watered and rammed into position.

Where specified as mortared stone pitching, the joints between stones shall be raked clean for their full depth and grouted with a 3 parts sand to 1 part Portland Cement mortar.

2.14 BACKFILLING OF PIPE TRENCHES

2.14.1 Plain Pipes

Structural fill shall be used for backfilling to a height of 300mm above the top of pipes and shall be compacted by means of an approved mechanical or a pneumatic tamper to not less than a density ratio of 95% as obtained in AS 1289.5.4.1 (modified compactive effort).

Care shall be taken so as not to disturb the pipe. Backfilling of the remainder of the trench shall be in accordance with the Earthworks section of this specification.

2.14.2 Perforated (subsoil) Pipes

Selected 10mm filter aggregate shall be used for bedding and backfilling to the pipe and shall be not less than 150mm thickness below and above the pipe and for the full width of the trench which shall be not less than 150mm either side of the pipe. The remainder of the trench shall be backfilled in accordance with the Earthworks section of this specification.

2.15 TESTING OF TRENCH BACKFILL DENSITY

The trench backfill density shall be tested in accordance with the Earthworks and Quality Assurance – Drainage sections of this specification.

2.16 AS CONSTRUCTED SURVEY AND DOCUMENTATION

2.16.1 Survey

Using the Contractor's quality assurance measure up (see Quality Assurance - Drainage), the "as constructed" survey shall be carried out and the results recorded by the Contractor's Licensed Surveyor. The costs of which are to be incorporated into the Contractor's lump sum tender.

The survey shall include all invert levels at access chambers, entry pits, headwalls and endwalls, centre to centre distance of pits, distances from centre of pits to headwalls or endwalls, size of pipes, types of pipes and bedding, location of pits in relation to adjacent boundaries, reduced levels of access chamber and entry pit covers.

2.16.2 Drawings

"As Constructed" drawings, conforming to the Local Authority's standards, shall be produced by the Contractor, and included in the lump sum tender.

These drawings when completed shall be signed and certified as accurate and correct by the Surveyor and Contractor before submitting to the Superintendent who will then forward onto the Local Authority for their approval.

2.17 CLEANING UP

Any damage done by the Contractor or his employees to buildings, fences, services, etc. shall be immediately made good to the approval of the Superintendent.

During the period of the Contract, the Contractor shall clean up the construction site and remove all surplus construction material and debris from the site. At the completion of the Contract the Site shall be clean and tidy, all excavations filled flush with the natural ground level, and all excess material removed.

The Contractor shall immediately reinstate any subsidence over trenches occurring at any time during the maintenance period.

3 ROADWORKS

3.1 GENERAL

All these works must be constructed in accordance with the drawings and this specification and will be subject to inspection and approval of the relevant Local Authority.

Any instructions from the Local Authority pertaining to the Works must be issued by that Authority to the Superintendent.

3.2 QUALITY ASSURANCE – ROADWORKS

The Contractor shall produce and submit weekly to the Superintendent verified records to confirm that the specification requirements have been achieved as follows:

Item as Specified	Test/Record	Frequency
1. Subgrade <ul style="list-style-type: none"> - Removal of unsuitable material - Finished level, alignment, width - Compaction 	Marked-up plan road plan Marked-up Compaction Certificate	Each occurrence 20m intervals 1 test per 250m ² of road
2. Sub-base <ul style="list-style-type: none"> - Finished level, depth of layer, alignment, width - Compaction - Material Specification 	Marked-up road plan Compaction Certificate Supplier's Certificate	20m intervals 1 test per 250m ² of road 1 test per project

Item as Specified	Test/Record	Frequency
3. Basecourse <ul style="list-style-type: none"> - Finished level, depth of layer, alignment, width - Compaction - Material Specification 	Marked-up road plan Compaction Certificate Supplier's Certificate	20m intervals 1 test per 1000m ² of road 1 test per project
4. Sprayed Primes and Seals <ul style="list-style-type: none"> - Material Specification - Actual bitumen application (temperature, rate area sprayed) - Cover application rate 	Supplier's Certificate Bitumen spray record Application record	1 per coat Each day Each day
5. AC Seal <ul style="list-style-type: none"> - AC Mix Specification - Compaction - Finished levels - Check for ponding - Depth and density of compacted asphalt 	Supplier's Certificate Confirm rolling procedure Marked-up roads plan Contractor's Certificate Certified core test hole results	1 for each day 1 for each day 20m intervals 1 for each day 1 per 500m ²
6. Clay Brick Paving <ul style="list-style-type: none"> - Material Specification - Bedding sand - Joint filling sand - Check for ponding - Accelerated loading 	Supplier's Certificate Grading curve Grading curve Contractor's Certificate Contractor's Certificate	1 per project 1 per project 1 per project 1 per project 1 per project
7. Kerbing <ul style="list-style-type: none"> - Concrete Specification - Width between kerb, contraction joints, expansion joints. - Curing 	Supplier's Certificate Marked-up road plans Contractor's Certificate	1 per deliver Width at 20m intervals, all joints. 1 for each day commenced and completed.
8. Street Signs <ul style="list-style-type: none"> - Posts and footings 	Contractor's Certificate	Each footing to be noted

All Compaction Tests shall be adequately distributed so as to give a good representation of the whole area.

The Contractor shall note on the record where any item fails to meet the specified requirement and the planned remedial action to be taken.

3.3 TOLERANCES

The following construction tolerances shall be achieved by the Contractor.

1.	Road centreline alignment	+ or - 100mm of centreline of road reserve
2.	Finished subgrade level	+ 5mm or - 30mm
3.	Sub-base width	+ 300mm and - 0mm
4.	Finished sub-base level	+ 10mm or - 20mm
5.	Basecourse width	+ 300mm and - 0mm
6.	Basecourse thickness	- 0mm
7.	Finished basecourse level	+ 10mm or - 10mm
8.	Basecourse surface shape: Crossfall Surface	+ or - 0.5% of design + or - 15mm when tested with a 3m straight edge, laid in

	Longitudinal grades	any direction. The gutter grade shall be + or - 20% of the design grade.
9.	Width of prime for AC	+ 150mm or - 0mm
10.	Width of primer seal	+ 150mm or - 0mm
11.	Thickness of AC	+ 5mm or - 0mm
12.	Finished AC or brickpaving level	+ 10mm or - 10mm
13.	Kerbing: Surface Level Line	+ or - 5mm when tested with a 3m straight edge + or - 5mm + or - 10mm

3.4 QUALITY ASSURANCE AUDITING

In order to audit the Contractor's testing programme, routine testing of materials and workmanship over and above the quality assurance schedule may be called for from time to time by the Superintendent at each stage of the roadworks. No work shall be commenced on the next stage until the existing work has been tested and approved by the Superintendent.

It shall be the Contractor's responsibility to advise the Superintendent when each stage of the work is ready for testing. All tests shall be arranged for by the Contractor at locations directed by the Superintendent with an independent testing authority registered with the National Association of Testing Authorities Australia for the tests required.

The Contractor shall give the Superintendent four (4) days notice of when the work will be ready for compaction tests. The Superintendent shall direct the location and type of testing required. The results of all tests shall be issued to the Superintendent by the Testing Authority.

All tests shall be paid by the Contractor directly to the Testing Authority concerned.

The Contractor may claim the cost of all tests requested by the Superintendent over and above the quality assurance schedule and the results of which indicate that the work or material is in accordance with the Contract.

Where tests indicate that the work or material is not in accordance with the Contract, the cost shall be borne by the Contractor.

3.5 MATERIALS

3.5.1 Australian Standard

All workmanship and materials used in the Works shall conform to the current Australian Standard where such Standard exists. Where such Standard does not exist the current Authority's Standard shall apply.

3.5.2 Limestone Rubble Sub-Base Material

The limestone rubble shall be obtained from an approved source, and shall be free from sand, capstone, roots and other foreign material.

The percentage of wear of the limestone, determined by the Los Angeles Test, shall not exceed sixty per cent (60%) weight loss.

The calcium carbonate content of the limestone shall not be less than sixty per cent (60%) nor in excess of eighty per cent (80%) by weight.

No grading requirements are laid down for the limestone rubble except that the maximum dimension of spalls shall not exceed 150mm, not more than 80% of the material shall pass through an AS 2.36mm Sieve and not more than 15% shall pass through an AS 75 micron Sieve.

The maximum dry compressive strength value shall not be less than 700 kPa.

Sampling and testing of limestone rubble shall be in accordance with AS 1141 and AS 1289.



A sample shall be taken and tested by the Testing Authority for calcium carbonate content, percentage of wear, grading, determination of the maximum dry density and maximum dry compressive strength of the material. If the material varies in quality or is obtained from various quarries, each variation in quality or material from each quarry used shall have this test performed by the Testing Authority and a record shall be maintained by the Contractor as to where the various materials have been placed.

Any material which does not meet the above requirements or which, in the opinion of the Superintendent or his representative, is composed of material which would break down with aging or weathering to such an extent that it would then fall outside the limits of this specification, shall be rejected.

3.5.3 Laterite Gravel

The gravel shall consist of a clean, durable laterite pebble and soil mortar free from roots, humus and other vegetable matter and shall have the following properties:-

All gravel shall pass the AS 37.5mm Sieve.

The grading shall be close to the maximum density curve and fall within the grading envelope, with a minimum of 90% of the material passing the AS 19.0mm Sieve. If the coarse fraction has a flatter curve than that of the envelope, the envelope shall begin where the slope of the grading falls below the upper curve of the envelope. The limits of the envelope shall be produced by plotting the equation:

$$P_1 = (D_1/D_2)^n \quad \text{Where } n = 1/3 \text{ and } 1/2 P_2$$

P_1 = % passing AS Sieve size D_1 P_2 = % passing AS Sieve size D_2

Dust Ratio - the ratio of:

Percentage passing the AS 75 micron Sieve / Percentage passing the AS 600 micron Sieve

shall not exceed 0.66.

The material passing the AS 0.425mm Sieve shall have the following properties:

Liquid Limit - not greater than 25

Plasticity Index - not greater than 6 or less than 2 The linear shrinkage shall not exceed 2%.

The dry compressive strength shall not be less than 2 MPa.

Sampling and testing of laterite gravel shall be in accordance with AS 1141 and AS 1289.

A sample shall be taken and tested by the Testing Authority for grading, dust ratio, liquid limit, plastic limit, linear shrinkage, dry compressive strength and maximum dry density of the material. If the material varies in quality or is obtained from various quarries, each variation in quality, or, material from each quarry used shall have this test performed by the Testing Authority and a record shall be maintained by the Contractor as to where the various materials have been placed.

3.5.4 Crushed Rock (Rock Base)

Rock base material shall consist of fine crushed rock, quarried from an approved source and shall consist of quartzite, granite, diorite, ironstone or other stone of approved hardness and durability and shall be free from clay lumps and excess organic or other deleterious materials. It shall be freshly blended, prior to delivery.

The grading of the portion passing an AS 19.0mm Sieve shall conform to the following requirements:-

Sieve Size (AS Sieve)	Percent by Weight Passing
19.0mm	100%
9.50mm	70-80%
4.75mm	40-65%
2.36mm	30-50%
0.425mm	12-30%
75 micron	3-12%



The ratio of the portion passing AS 75 micron Sieve to the portion passing AS 0.425mm Sieve shall fall within the range 40 - 60%. The portion of the total sample retained on the AS 19.0mm Sieve shall not exceed 5% of the total sample and the maximum size of any stone shall be 40mm.

The portion of the sample which passes the AS 0.425mm Sieve (Soil Mortar) shall conform to the following requirements:

- The Liquid Limit shall not exceed 25.
- The Plasticity Index shall not exceed 5 nor be less than 2.
- The Linear Shrinkage shall not exceed 2%.
- Sampling and testing shall be in accordance with AS 1141 and AS 1289.
- The Dry Compressive Strength shall not be less than 2 MPa, as measured in accordance with MRD Test WA 140.1.

A sample shall be taken and tested by the Testing Authority for grading, liquid limit, plastic limit, plasticity index, linear shrinkage, dry compressive strength and maximum dry density of the material. If the material varies in quality or is obtained from various quarries, each variation in quality, or, material from each quarry used shall have this test performed by the Testing Authority and a record shall be maintained by the Contractor as to where the various materials have been placed.

Notwithstanding this specification, any sample which, in the opinion of the Superintendent, is composed of unsuitable material, or is composed of material which would break down with aging or weathering to such an extent that it would then fall outside the limits of this specification, shall be rejected.

3.5.5 Bitumen

The bitumen used is to be a straight run slightly blown bitumen distilled from an asphaltic base petroleum. The grade is to be class 170 (140-200 pascal second viscosity at 60 degree Celsius). The bitumen is to conform to AS 2008 and the current N.A.A.S.R.A. Specification. The minimum density at 25 degrees Celsius shall be 1.0 Kg per litre.

3.5.6 Cutting Oil

The cutting oil to be used shall be medium curing conforming to the following requirements:-

Property	Requirement
Initial boiling point	132-160°C
Final boiling point	265°C Max
Temperature at 50% recovery	220°C Max
Flash point (open)	35°C Min
Density at 25°C	0.78-0.82kg/L
Percentage aromatics	15% Min (volume)
Miscibility with equal parts of Class 170 bitumen	Complete, no precipitation
Viscosity at 40°C	1.0 - 1.4mm sq/s
Water content	0.05% Max

1.1.1 Fluxing Oil

The fluxing oil shall be slow curing petroleum product distillate fuel oil conforming to the following requirements:

Property	Requirement
Initial boiling point	170-195°C
Final boiling point	360-400°C
Temperature at 50% recovery	250-290°C
Flash point	65°C
Miscibility with equal parts of Class 170 bitumen	Complete, no precipitation
Viscosity at 40°C	2.0–4.0mm sq/s
Water content	0.05% Max

3.5.7 Bitumen Emulsion

Bitumen emulsion shall conform as regards physical qualities, sample and testing with the AS 1160, with the following amendments :-

Water Content - the emulsion shall not contain more than 40% by weight of water. Specific Gravity - the specific gravity at 16 degrees Celsius shall not be less than 1.00. Bitumen used is to be class 170.

Alternative specification can be submitted by the Contractor provided that:

- (a) Bitumen content - the residual bitumen content of the emulsion must be stated.
- (b) Additives - the addition of up to 2% by volume of additives may be required by the Superintendent.
- (c) Patents - the emulsion to be used shall be manufactured under an approved patent.

Contractor must set out facilities and have spray tankers available for spraying emulsion direct onto the road.

3.5.8 Aggregate

The aggregate used for surfacing roads shall consist of crushed diorite (or granite) stone which shall consist of clean, tough, durable fragments free from an excess of thin or elongated pieces, free from soft or disintegrated pieces, stone coated with dirt, or other deleterious matter, in compliance with AS 2758.2.

The Bulk Specific Gravity of the particles of diorite shall not be less than 2.90 (2.60 for granite).

Should it be found on testing that material delivered to stockpile does not conform to these specifications, such material shall be removed from the site and replaced with suitable aggregate.

Flakiness index of granite shall not exceed 30.

The limits on percentage of aggregate passing AS Sieves, by mass of sample shall be as follows:

Nominal Grading of AS sieve	5mm	7mm	10mm	14mm
19.0mm	-	-	-	100%
13.2mm	-	-	100%	95-100%
9.50mm	-	100%	90-100%	30-50%
6.70mm	-	80-90%	0-35%	0
4.75mm	100%	0-35%	0-2%	-

Nominal Grading of AS sieve	5mm	7mm	10mm	14mm
2.36mm	-	0-3%	0-2%	-
1.18mm	30-80%	0-2%	0-1%	-
600 micron	0-20%	-	-	-

The Superintendent will, as necessary, vary the grading shown above to suit aggregate material selected.

3.5.9 Asphaltic Concrete

The asphaltic concrete shall be a mix of clean, dry graded coarse and fine aggregates, mineral filler and class 170 bitumen, in accordance with AS 2150.

The temperature of the mix as delivered to the point of spreading shall be not less than 120 degrees Celsius.

The materials used in the mix or mixes shall conform to the following proportions and requirements. The mix shall be made in a "batch" or "drum" type of plant.

The material shall be a mixture of clean diorite to be rescreened and held in storage bins for direct use in mixing plant. The sand shall be clean, sharp sand, free of any silt, clay, salt or other foreign matter.

The bitumen shall be as specified in this specification.

The grading of the mix shall conform to the following limits on percentage passing AS Sieves, by mass of sample:-

Nominal Mix Size AS sieve	AC7	AC10	AC14
19.0mm	-	-	100%
13.2mm	-	100%	85-100%
9.50mm	100%	90-100%	70-85%
6.70mm	90-100%	70-90%	62-75%
4.75mm	68-88%	58-76%	53-70%
2.36mm	49-67%	40-58%	35-52%
1.18mm	37-53%	27-44%	24-40%
600 micron	25-41%	17-35%	15-30%
300 micron	15-27%	11-24%	10-24%
150 micron	8-16%	7-16%	7-16%
75 micron	4-8%	4-7%	4-7%
Bitumen content to be	5-7%	5-7%	4.5-6.5%
Minimum Marshall Stability of compacted mix	5.5kN	6.5kN	6.5kN
Marshall flow value	2-4mm	2-4mm	2-4mm
Percentage voids in compacted mix to be in the range of	3-5%	3-7%	3-7%

3.5.10 Concrete

Concrete shall conform to AS 3600 and shall be supplied by a concrete supplier conforming with AS 1379. Concrete shall have a characteristic strength of N25, 60mm slump and maximum aggregate size of 20mm. Concrete strength shall be tested by means of product assessment methods in accordance with Section 20.4 of AS 3600. The Contractor shall register the project and arrange for results to be sent to the Superintendent.

On site mixing of concrete may be used subject to the Contractor's proposal of mix details being submitted to and approved by the Superintendent. Site mixed concrete shall be subjected to site testing for slump and strength in accordance with the relevant Australian Standards.

3.5.11 Water

Water used for concrete or compaction of pavement materials shall be of potable quality, free from any impurities harmful to concrete or the pavement material being compacted and where public supply is used the Contractor shall obtain the supply Authority's approval to the use of the water for the Contract.

3.5.12 Sand

Sand for mortar will be crushed stone or natural sand in accordance with AS A123.

Sand for bedding or backfilling, when required, shall be clean sand or fine gravel as defined by AS 1289 grading chart figure C6.1.1. It shall be free from roots, clay or any deleterious matter and shall have a maximum nominal particle size of 4.75mm.

3.6 PLANT

3.6.1 Bitumen Sprayers

Bitumen sprayers shall be of 2,700 litres minimum capacity and shall comply with the requirements for bitumen sprayers set out in the NAASRA Publication "Specification for Mechanical Sprayer of Bituminous Materials". The sprayer shall have been tested for uniformity of transverse distribution and calibrated for overall rates of application. The tests shall be performed within three months prior to use of the sprayer in the works up to spray rates at least 15% higher than specified herein. The certificates and charts applying to such tests shall be made available to the Superintendent. The Superintendent may require the sprayer to be made available free of charge for inspection and testing prior to or during the execution of the works.

3.6.2 Rollers

Steel wheeled power rollers shall be three wheel tandem rollers of between 6 and 15 tonnes gross weight and the load per metre of any wheel shall not exceed 5 tonnes.

Pneumatic tyred power rollers shall be of the self-propelled type weighing not less than 15 tonnes gross weight and having "square section" tyres at a pressure of not less than 700 KPa.

3.6.3 Brooms

A rotary road broom of approximately 2 metres width is required and the broom must be capable of being turned up to 45 degrees either way.

The rotary drawn broom must be capable of being used as a drag broom or a drag broom must be provided.

3.6.4 Graders

Blade graders shall weigh not less than 5 tonnes and shall have a wheel base of not less than 4.5 metres and a blade not less than 3 metres long. The cutting edge shall be checked for straightness against a straight edge.

3.6.5 Water Tankers

Water tankers shall have boom sprays and a quick acting valve (plug cock or similar).

3.7 SURVEY INFORMATION

Prior to Contract acceptance all road centre lines will be staked at 20 metre intervals and at all tangent and intersection points.

3.8 ROAD RESERVE PREPARATION

3.8.1 Clearing

The road alignment shall be cleared for the width of the road reserve and shall extend 20m beyond the start and end of the road to be constructed except cul-de-sac and 20m along each cross street measured from the centreline of the road being cleared.

Clearing shall be carried out in accordance with the "Clearing" clause in the Earthworks section.

3.9 SUB-GRADE

3.9.1 General

The entire width of the road reserve shall be cut or filled as necessary to conform with the levels given on the drawings.

After excavation or filling, compacting, trimming and boxing out, the finished surface of the road sub-grade shall conform to the lines, grades, shape and dimensions shown on the drawings.

Any surplus material shall be spread on road margins to approved levels or dumped at approved sites within one kilometre from the original site and spread and trimmed. Additional filling, where a deficiency occurs, shall be carted to the site.

The subgrade shall consist of a uniform type material. Where the in-situ material varies then the Superintendent shall direct any over excavation and replacement with approved material, either from site or off site to achieve a stable subgrade. The Contractor shall remain responsible to reasonably assess the site conditions and shall allow for the costs of any additional work in his lump sum tender.

3.9.2 Compaction

Sub-grade shall be compacted to not less than 95% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-1993) to a minimum depth below the surface of 300mm. Sub-grade to be formed to grade, crossfall etc. to ensure that an even thickness of pavement can be finally achieved.

No further stage of construction to be commenced until the completed sub-grade has been inspected and approved by the Superintendent and the Local Authority.

3.10 SUB-BASE

3.10.1 General

Limestone sheeting is to be laid in one thickness, care being taken to ensure that the sub-grade is not disturbed.

3.10.2 Compaction

Limestone shall be watered to optimum moisture content and compacted by rolling to a density of not less than 95% of the maximum modified dry density obtained in modified maximum dry density tests (AS 1289.5.2.1-1993).

The sub-base shall be cut to grade, crossfall, etc. free from local hollows and high spots.

3.10.3 Testing

After the sub-base has been prepared and compacted, no work is to be commenced on the base until the Superintendent and the Local Authority are satisfied that the specified shape, compaction and course thickness has been achieved.

3.11 BASECOURSE

3.11.1 General

The base material shall be placed so that the sub-grade or the sub-base (when a sub-base has been specified), is not disturbed and broken up and that an even thickness is obtained.

3.11.2 Compaction

The base shall be watered, compacted and cut to grade and crossfall as noted on the drawings. Compaction shall be to not less than 98% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-1993).

The surface of the base course after trimming and compaction shall be even and true to required shape, grade and surface condition ready for priming. If subsequent testing reveals an uneven surface or a lesser depth of material than specified above, the top of the base course shall be scarified, further material added as required, shaped and compacted to the requirements of the specification.

After preliminary consolidation, the placed base course material shall be lightly scarified and further material added as necessary to give the required compacted depth. The loose layer shall be thoroughly blade-mixed to its full depth by means of an approved grader.

3.11.3 Stabilised Limestone Basecourse

As an alternative, the base course may be constructed using stabilised limestone.

This course shall consist of insitu crushed limestone stabilised by mixing with a nominated percentage of bitumen emulsion stabiliser.

The bitumen emulsion stabiliser shall be mixed into the limestone at the rate of 2% residual bitumen content by weight of the maximum dry density of the limestone. The binder shall be a slow setting bitumen based emulsion with 60% residual bitumen content. Grading shall be 180-210 penetration.

The limestone shall be tyned to the nominated depth and shall be raked to remove all material in excess of 19mm diameter. Prior to stabilising, the limestone surface shall be shaped up to required road levels. To reduce the quantity of water required to bring the limestone stabiliser mix to optimum moisture for compaction, the prepared limestone must be kept damp.

The stabiliser shall be spread uniformly over the prepared limestone bed by means of an approved spreading

machine.

The full depth of the materials required to give the nominated compacted base course thickness shall be thoroughly mixed with an approved machine. The mixing operation shall continue until the Superintendent is satisfied a uniform material has been obtained over the full required depth. Sufficient water shall be added during the mixing process to enable the stabilised limestone to be compacted over its full depth.

After thoroughly mixing the material it shall be graded to a level suitable to give the required finish levels after compaction. The material shall then be rolled with an approved vibrating steel roller to seal the surface against loss of moisture by evaporation. The mix shall then be trimmed where necessary with a suitable grader during compaction.

The compaction shall be with an approved vibrating roller and shall be finished off with a multi-rubber tyred roller. Material trimmed from the pavement during compaction shall be pushed to waste and carted from Site.

The compaction of the stabilised limestone base course shall not be less than 95% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-1993).

Where it is necessary to raise levels to conform to the required grades, tye the pavement to half depth and rework the material. The Contractor shall complete all grading and compaction of the pavement within 24 hours of mixing. Water should be added during this operation.

If the pavement shows evidence of ravelling, pot holes, corrugations, subsidences or lack of cohesion, indicating unsatisfactory stabilised areas, the pavement concerned shall be loosened uniformly by tyning and the rejected area excavated and replaced by suitably compacted material as directed by the Superintendent.

The unsatisfactory material so excavated shall be removed from the Site.

3.11.4 Surface Shape

During final shaping and compacting, the shape shall be checked frequently and corrected as necessary by grading under the direction of an experienced foreman. The crossfall, super-elevation and smoothness of grade shall be checked with a straight edge and built-in level. The finished level shall allow for the thickness of the seal coats.

The Contractor shall provide a 3m straight edge and spirit level required for checking purposes and shall make these, together with the necessary labour, available to the Superintendent when required.

The longitudinal profile at the kerblines of the completed road shall conform to the design levels within the tolerance given in the sub-clause "Tolerances".

Where the shape of the compacted road or the thickness of the base courses do not comply with the requirements of this specification, the Contractor shall correct the same, at his cost, by scarifying, adding or removing materials as required, recompacting and trimming as necessary to comply with the requirements of this specification.

3.11.5 Testing

After the base has been prepared and compacted, no sealing shall be commenced until the Superintendent and the Local Authority are satisfied that the specified shape, compaction and course thickness of the base has been achieved.

3.12 ROAD CROSSINGS - ELECTRICAL SERVICES

3.12.1 General

The Contractor shall supply and install ducts for service crossings at the locations and to the sizes as shown on the drawings.

3.12.2 Materials – Underground Electric Power Crossings

Materials used for Underground Electric Power Ducts shall conform to the following Australian Standards :

a) AS 2053
Category A - PVC - coloured orange for 40mm external diameter.

b) AS 1477 Part 1
Category A - class PD - PVC - coloured orange for sizes 75mm, 100mm and 150mm internal diameter.

c) AS 1711
Class B fibrolite ducts for sizes 80mm, 100mm and 150mm all internal diameter may be used as an alternative to PVC.

3.12.3 Installation of Underground Electric Power Ducts

All ducts shall have a minimum cover of 750mm to the top of the duct and shall be bedded in sand for a minimum distance of 150mm below the lowest duct and 150mm above the highest duct. No duct shall be installed with more than 1100mm cover.

Ducts shall be laid in a horizontal formation up to four ducts thereafter in tier formation.

Length of ducts shall be width of road and footpath plus a minimum 1000mm projection on both sides. All ducts shall have draw wires and end caps.

Marker tape shall be installed 300mm below ground level and above the duct, and brought out to ground level at each end, with a steel star picket marker peg at one end.

3.12.4 Backfill to Ducts

Backfilling over all ducts shall be of sand compacted in maximum 300mm thick layers to not less than 95% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1).

3.13 PRIME FOR ASPHALTIC CONCRETE SURFACING

3.13.1 General

Priming shall be carried out under favourable weather conditions and the prepared base course shall be sufficiently dry to permit adherence to and penetration of the base course by the bitumen.

Before priming, the pavement shall be broomed free of all loose material and dust, and any defects are to be made good. Should conditions require it, the surface shall be lightly watered immediately prior to the application of the primer.

The primer shall be a cutback primer consisting of 70% residual bitumen and 30% power kerosene or, should weather conditions preclude the use of cutback primer, the Superintendent may approve a bitumen emulsion prime.

The application rate of primer, either cutback or emulsion, shall be 1.00 litre (total mixture) per square metre. The cutback primer shall be applied at a temperature of 60 degrees Celsius.

Emulsion primer may be heated to a maximum temperature of 50 degrees Celsius if conditions warrant it. The application rate shall be taken as the quantity measured at 15 degrees Celsius for all primers.

3.13.2 Blinding

Blinding for Cutback Prime - sand or 1.5mm aggregate.

This shall be applied after penetration of the primer but while sufficient bitumen is on the surface to allow adhesion. The blinding material shall be applied at a sufficient rate to prevent lifting of the primed surface by vehicles.

Blinding for Emulsion Prime - 3mm aggregate.

The 3mm aggregate shall be evenly applied immediately after spraying at the rate of 80 square metres of primed surface per one cubic metre of metal. The surface is to be rolled until screenings are firmly embedded in the primer.

3.13.3 General

Priming shall be carried out under favourable weather conditions and the prepared base course shall be sufficiently dry to permit adherence to and penetration of the base course by the bitumen.

Before priming, the pavement shall be broomed free of all loose material and dust, and any defects are to be made good. Should conditions require it, the surface shall be lightly watered immediately prior to the application of the primer.

The primer shall be a bitumen emulsion prime.

The application rate shall be 1.36 litre per square metre, measured at 15 degrees Celsius.

Emulsion primer may be heated to a maximum temperature of 50 degrees Celsius if conditions warrant it.

In certain circumstances, the Superintendent may approve the use of a cut-back bitumen prime. In such cases, the surface shall be primed with a medium curing cut-back bitumen applied at a rate of not less than 1.2 litre/sq.m measured at 15 degrees Celsius and at a temperature between 70 and 120 degrees C. The proportion of MC Cutter oil and application rate shall be dependent on the condition of the base surface and traffic density.

3.13.4 Blinding

The primer shall, immediately after spraying, be covered with approved 7mm diorite or granite so that all sprayed areas shall be completely covered within a period of 15 minutes.

The cover material shall be spread by means of an approved aggregate spreader attached to the body of a motor vehicle transporting the metal. Such equipment shall be capable of spreading a uniform layer of aggregate.

Rate of application shall be at a maximum of 150 square metres per cubic metre of metal, controlled so that only sufficient is applied to give a uniform dense mat one stone thick. Additional aggregate shall be added by hand spreading to any bare or insufficiently covered areas as necessary to produce the required uniform cover.

Within 15 minutes of the application of the aggregate, rolling shall commence with a 5 to 8 tonne self-propelled steel wheel roller. This initial rolling shall preferably consist of at least three complete rolls over the area concerned but, should any general crushing occur under the rollers, such rolling shall be stopped regardless of the number of rolls completed.

The surface shall then be back rolled with a pneumatic tyred roller until proper interlocking of the chipping and adhesion of the binder to the stone takes place. During this operation, the material is to be constantly broomed to ensure that an even layer of material is equally spread and rolled hard.

3.14 ASPHALTIC CONCRETE SURFACING

3.14.1 Primer Seal

Primer sealing shall be carried out under favourable weather conditions and the prepared base course shall be sufficiently dry to permit adherence to and penetration of the base course by the bitumen.

Before primer sealing, the pavement shall be broomed free of all loose material and dust and any defects are to be made good. Should conditions require it, the surface shall be lightly watered immediately prior to the application of the primer.

No primer sealing shall be applied whilst the pavement surface temperature is less than 15°C or during wet, windy or rainy conditions, or when adverse weather conditions may prevail at any time during the work.

The proportion of cutter oil in cut-back bitumen and application rate shall be dependant on the condition of the base surface and traffic density. The **residual** application rate of primer binder should be approximately 0.8 to 1.0 litres per square metre (measured at 15 degrees Celsius), however, the Contractor is responsible to assess the conditions and with approval from the Superintendent adjust these application rates to suit.

A bitumen emulsion primer seal may be used by the Contractor with prior approval of the Superintendent.

The primed surface shall be covered with 7mm aggregate screenings at sufficient rate to achieve a uniform dense mat with no excess surface bitumen. Aggregate shall be rolled with a 6 - 8 tonne roller until screenings are firmly embedded in the primer. Should any general crushing occur under the rollers, such rolling shall be stopped and direction sort from the Superintendent regardless of the number of rolls completed.

3.14.2 Open to Traffic

If the road is to be left open to traffic before final surfacing, aggregate must be swept wherever required to remedy heaping and corrugation and, as soon as there is no danger of bitumen being picked up by traffic, the surplus may be swept off.

3.14.3 Preparation of Surface for Asphaltting

Prior to asphaltting occurring, the existing primerseal surface shall be inspected and any required corrections of defects agreed with the Superintendent and Local Authority should be undertaken.

Excess binder shall be removed from any faulty areas, pot-holes or depressions filled with suitable material, and any deviations to the pavement shape corrected prior to the application of the tack coat. If directed, the whole surface must be given a second primer seal coat.

Pot holes shall be repaired by cutting back into sound road material, with vertical faces, filling and compacting in layers with road base material, and re-sealed.

3.14.4 Tack Coat

When ready for the final seal, the primer sealed surface shall be broomed free of all loose material and a tack coat shall be applied to provide a "key" for asphaltic concrete.

Application shall take place not less than 30 minutes nor more than 2 hours before placing asphaltic concrete.

The tack coat application rate shall achieve a residual bitumen of 0.1 to 0.2 litres per square metre. With approval from the Superintendent, this rate may be varied to suit the class of material.

No asphalt shall be laid on an emulsion tackcoat until the emulsion has broken and the water has substantially evaporated.

Any pools of tack coat which may have formed in surface depressions shall be brushed out.

3.14.5 Asphaltic Concrete

Asphaltic concrete shall be laid at a rate so as to achieve a compacted thickness of:

- For major intersections as noted; 40mm, using a 14mm nominal graded mix
- All other road areas; 30mm, using a 10mm nominal graded mix.
- AC footpaths; 25mm AC10 with red oxide (% to Shire of Denmark specification to match existing)

The asphaltic concrete mix shall be placed at a minimum temperature of 140 degrees Celsius immediately on delivery to the spreader and in the presence of experienced personnel. The temperature of the asphaltic concrete at the time of initial rolling must not fall below 120 degrees Celsius. Spreading of material below this temperature will not be permitted. No asphaltic concrete shall be placed when the ambient temperature is less than 10 degrees Celsius.

The asphaltic concrete shall be placed in one layer by an approved self propelled machine spreader, conforming to AS 2150, Section 12.

Compaction shall be accordance with AS 2150 Section 13 except as follows:

Compact initially by rolling with at least two coverages of the smooth, steel drum tandem roller as specified under the clause on "Plant". Immediately following the initial rolling and while the asphaltic concrete is still hot, roll with not less than twelve coverages of the self-propelled pneumatic-tyred roller, of mass not exceeding 12 tonnes, as specified under the Clause on "Plant". Roll finally with a maximum of two coverages of the smooth, steel drum roller while the asphaltic concrete is sufficiently warm to produce a smooth, dense surface.

If the asphaltic concrete begins to shove or crack, in no circumstances continue with rolling until the cause has

been determined and corrective measures taken. Keep drums and wheels of rollers wet with water and clean during all rolling operations.

Form any joints necessary and ensure that the finished profile is smooth and even over the joints without ridges or depressions. Joints shall be waterproof. Joints shall be in accordance with AS 2150 Section 12.6.

The density of the compacted concrete shall be not less than 97% of the Marshall maximum density. The design levels given on the drawings indicate the levels of the finished road surface.

3.14.6 Testing

Samples of the compacted asphaltic concrete shall be taken by an appropriate testing consultant as set out in the Quality Assurance section of this specification and the field density determined. The samples will be taken for the full depth of the layer and may be either approximately square or diameter cores.

All density holes shall be repaired by the Contractor.

The Contractor shall submit a record of the grading of the mix and any test results requested by the Superintendent.

3.15 EXTRUDED CONCRETE KERBING

3.15.1 General

Kerbs to roads shall be constructed of extruded concrete kerbing. Kerbing to smaller radii than can be placed with the extrusion machine used shall be cast insitu to the same cross section as that of the extruded kerbing, except that the cast insitu kerb shall be 100mm deeper than the extruded kerbing and shall be embedded firmly in the road surface to the extra depth. The outward appearance of the extruded and cast insitu kerbing shall be identical.

3.15.2 Kerb Construction

All kerbing shall be constructed from 25 MPa 28 day cylinder test compressive strength concrete manufactured in accordance with AS 3600 for 10mm aggregate with a 50mm slump.

The final shape and dimensions of the extruded kerb shall be as detailed on the drawings. The top surface of the kerb shall always be parallel to the ruling grade of the pavement, with gentle transitions at changes in grade.

The kerb shall be placed in straight lines and in circular curves as shown on the drawings. The width of the road shall be the distance between the kerbs along straight sections of the road measured at right angles to the kerbs from toe to toe and shall be as detailed on the drawings. The kerbs shall be equidistant from the road centre line. At road junctions and intersections, the radius or kerbing shall be measured from the road side toe of the kerb.

The kerb shall be placed using an appropriate extrusion machine, approved by the Superintendent and the Local Authority and the work shall be carried out by an experienced and competent crew. The first 150mm of any new pour shall be cut away and removed. The gap between the old and new work shall be filled by hand placing, rodding and shaping of the concrete until a satisfactory shape and finish has been obtained. Extruded kerb shall be joined to existing kerbing by using the same method.

The extruded kerb shall be finished by means of a kerb shaped screed.

3.15.3 Contraction Joints

Contraction joints shall be constructed at 2.0m intervals, and at tangent points of sweeps, by complete separation of adjoining sections of the kerb immediately after extrusion.

The kerb is then finished by using the screed.

Each contraction joint shall be defined by a groove cut in the finished surface on the entire exposed face of the kerb before the concrete has set, to a depth of 15-20mm.

3.15.4 Expansion Joints

Not less than 24 hours after placing of the kerb expansion joints shall be constructed at every second contraction joint. The expansion joints shall be formed by the sawing of a 10mm gap that completely severs the adjoining sections of the kerb. The gap shall be filled with approved joint filler after the Superintendent and the Local Authority have inspected and approved the cut joints.

Expansion joints shall be placed where the kerb meets a side entry or combination pit.

3.15.5 Curing

Within two hours of surface finishing, all exposed faces of the completed kerb shall be protected against loss of moisture for a period of not less than 96 hours after placing by shrouding with plastic sheeting or by spraying with a curing compound complying with AS 3799.

3.15.6 Protection

Kerbs shall be protected from bitumen overspray at all times by adequately covering the kerbs with polythene sheeting or similar approved material.

Any kerbing marked by bitumen spray shall be made good by the Contractor at his own expense.

3.15.7 Backfilling

The backfilling to kerbing shall be placed as shown on the drawings after the curing and acceptance of the kerbing. The backfill material to be a similar material to the locally occurring topsoil, free from debris and compacted adequately to accommodate the driving of rubber tyred domestic vehicles.

3.15.8 Cleaning Up

The Contractor shall remove any excess mortar or concrete spillages from the road surface prior to completing the pavement construction.

During completion of the pavement, the Contractor shall take every care to avoid damage and bitumen spillage onto the kerbs. Where damage or spillage has occurred, the Contractor shall make good this damage and remove bitumen spillages at his own expense.

3.16 STREET NAMEPLATES

3.16.1 General

Street signs shall be erected by the Contractor at all road junctions and intersection. These shall consist of a single sign or multiple signs as shown on the drawings.

3.16.2 Post

Details shall be as shown on the standard drawings.

3.16.3 Nameplates

The nameplates, fittings and attachment post shall be as specified in this clause and as detailed on the drawings unless this varies from the Local Authority's standards in which case the Local Authority's standard details shall apply.

Nameplates shall be of 150mm height extruded aluminium. The length to suit the street name, but not less than 450mm and not longer than 1000mm, and shall be in multiples of 50mm.

The nameplate shall be reflectorised white with 100mm high black embossed lettering, unless otherwise required by the Local Authority.

The lettering shall be of block type, series C of AS 1744. Abbreviation, where used, shall be selected from the following:



Name	Abbreviation	Name	Abbreviation	Name	Abbreviation
Alley	Al	Drive	Dr	Ramble	Ra
Arcade	Arc	Esplanade	Es	Rise	Ri
Avenue	Ave	Gardens	Gdns	Road	Rd
Boulevard	Blvd	Grove	Gr	Row	Rw
Circle	Ci	Highway	Hwy	Square	Sq
Circus	Cs	Lane	La	Street	St
Close	Cl	Loop	Lp	Terrace	Tc
Corner	Cnr	Mews	Me	Trail	Trl
Court	Ct	Parade	Pde	Vale	Val
Courtyard	Ctyd	Parkway	Pkwy	Walk	Wk
Crescent	Cr	Place	Pl	Way	Wy
Cross	Cro	Promenade	Pro		

The nameplate shall be attached to the post with a standard aluminium bracket and two 10mm diameter cadmium plated bolts, unless otherwise required by the Local Authority.

3.17 POST AND RAIL FENCING

Post and rail fencing shall be installed along the reserve edge of a major road where it abuts a cul-de-sac, or local frontage road, or at locations detailed on the approved drawings.

The timber shall be tanolith treated pinus radiata of reasonable uniformity in diameter specified per length and free of any noticeable bends or defects in its overall appearance.

3.17.1 Uprights

The uprights shall be between 125mm and 150mm diameter set at 2.00m centres and 1.125m in length and 675mm above ground level.

3.17.2 Railings

The railings shall be a minimum of 100mm diameter 3.35m in length with 650mm spacings between rails. Rail to be fixed by 12mm galvanised cuphead bolts and galvanised washers set 150mm below the top of the upright.

3.17.3 Installation of Upright

All equipment to be secured into the ground by the extension of the upright 450mm into the ground may be by means of a concrete block 450mm in diameter extending 500mm into the ground around each footing, set 50mm below ground level. All concrete shall be minimum 20 MPa 28 day cylinder test compressive strength.

3.17.4 Finish

Excess thread on bolts shall be removed, burred over and cold galvanised. All end grain cuts in the timber shall be cut clean to eliminate splintering. Any damaged or split sections shall be replaced if deemed necessary by the Superintendent at the Contractor's expense. It shall also be the Contractor's responsibility to remove all stains and splashes of concrete on wooden uprights.

3.18 AS-CONSTRUCTED

The Contractor shall arrange for all as-constructed survey, testing of thickness and presentation of results using a licensed surveyor at the Contractor's expense.

The as-constructed information shall be signed and certified as accurate and correct by the contractor and the Licensed Surveyor before being submitted to the superintendent for approval.

This information shall be submitted to the Superintendent prior to Practical Completion and prior to acceptance of the works.

4 FOOTPATHS

4.1 GENERAL

All these Works shall be constructed in accordance with the drawings and this specification and will be subject to inspection and the approval of the relevant Local Authority.

Any instructions from the Local Authority pertaining to the Works shall be issued by that Authority to the Superintendent.

The extent of footpaths and footways to be constructed is as shown on the drawings. Footpaths may not be constructed until after all drainage, sewerage, major verge clearing and kerbing have been completed.

4.2 CLEARING

The footpath alignment shall be cleared for the width of the footway reserve. Only trees specifically nominated by the Principal or the Superintendent shall be retained.

Clearing shall be carried out in accordance with the "Clearing" clause in the Earthworks section.

4.3 SUB-GRADE

The entire width of the footpath reserve shall be cut or filled as necessary.

After excavation or filling, compacting, trimming and boxing out, the finished surface of the footpath sub-grade shall conform to the shape and dimensions shown in the drawings.

Sub-grade is to be compacted to not less than 95% of the maximum dry density obtained in modified maximum dry density compaction tests (A.S. 1289.E.2.1) to a minimum depth below the surface of 500mm.

All filling shall be placed in generally horizontal layers not exceeding 250mm and compacted prior to the placing of further material.

A sand bed of clean sand free from roots, clay or any deleterious matter shall be placed to a minimum compacted thickness of 50mm and to the designed footpath width. The bedding shall be compacted to not less than 95% of the maximum dry density obtained in the modified maximum dry density compaction tests (AS 1289.E.2.1).

Where paths will be trafficked (such as at crossovers), 150mm of sub-base shall be installed beneath the path (sand bed). Refer to section 3.10.

4.4 CAST INSITU CONCRETE PATHS

4.4.1 Dimensions

The footpath shall be constructed with a crossfall of 2% towards the kerb. The finished thickness of the slab to be a minimum of 100mm. The width of the path shall be as shown on the drawings.

4.4.2 Construction

The path shall be placed on the prepared sand bed which shall be screeded to profile and crossfall to provide the finished slab thickness.

Where the path is constructed in the road reserve, the longitudinal profile of the path shall be the same as the longitudinal profile of the adjacent kerbing. Elsewhere, the path longitudinal profile will be such as to achieve a uniform grading and generally conform to the surrounding finished ground or as shown on the drawings.

No concrete shall be poured until the sand bedding has been approved by the Superintendent. Rails or guide posts shall be erected to suit the construction programme.

4.4.3 Concrete

The concrete used in this construction shall conform to AS 3600 and be provided by an approved pre-mixed concrete supplier, conforming with AS 1379. Each batch provided shall be supported with evidence of strength slump, aggregate size, etc.

Concrete shall be of 25 MPa at 28 day cylinder test compressive strength, with a slump of 75mm and a maximum aggregate size of 14mm.

The concrete, when placed, must be well tamped to remove all voids and to work fines to the surface for trowelling.

4.4.4 Contraction Joints

Contraction joints in footpaths and cycleways shall be constructed at 2.0 metre centres for footpaths, footways and cycleways.

Joints shall be neatly defined with a jointing tool and smooth trowel finished for 80mm either side of the joint. Joints shall be aligned with joints in the kerbing where the path is against the kerbing.

Should 'Lockjoint' joints be preferred by the Shire of Denmark, the Contractor shall install as per the manufacturer's specification.

4.4.5 Expansion Joints

At 4.0 metre intervals expansion joints shall be constructed 12mm wide for the full depth of the slab. A 35mm x 12mm bitumen impregnated canite or foam of an approved type shall be inserted in the joint and finished flush with the surface of the path. The expansion joints shall be marked out with an edging tool to match the appearance of the contraction joints. Expansion joints shall be installed where the pathway abuts utility service structures, drainage/sewer pits and crossovers, and align with joints placed in kerbing where path is placed against kerb.

Should 'Lockjoint' joints be preferred by the Shire of Denmark, the Contractor shall install as per the manufacturer's specification.

4.4.6 Finish

The surface finish shall be a deep broom finish (2mm), with a polished smooth edge approximately 75mm wide at edges and joints using an edging tool. The broomed finish shall be such that it is perpendicular to the direction of pedestrian traffic.

The alignment of the edge of the path is to be straight and true to line. Deviations from alignment or from specified width will not be accepted. The path shall be parallel with the kerbing in vertical and horizontal alignment.

The finished path shall be protected from damage by passers-by and with polythene film for 24 hours after completion if rainfall during this period is apparent.

4.4.7 Curing

The entire footpath shall be protected against loss of moisture for a period of not less than 72 hours after placing by shrouding with polythene sheeting or by spraying with a curing compound complying with AS 3799.

4.4.8 Protection

Barricade, warning signs and lights shall be erected to prevent damage of the footpath from vehicles and pedestrians for not less than 24 hours after completion.

The Contractor is responsible for protection of the path against damage of any kind during the period of setting and curing of the concrete.

4.4.9 Clean Up and Backfilling

All cement droppings, slurry, etc. and surplus materials to be removed from site.

All formwork, pegs, stakes, etc. shall be removed after the curing of the path has been completed.

After removal of the formwork, and acceptance of the path by the Superintendent and the Local Authority, the path shall be backfilled with a clean sand. Backfilling shall be compacted to not less than 90% of the maximum dry density obtained in modified maximum dry density compaction tests (AS 1289.5.2.1-1993) and shaped level



with the top of path.

4.5 ASPHALT FOOTPATH

4.5.1 General

Construction for Asphalt Paths shall be as for Asphalt Roads, see section 3.0 ROADS.

EARTHWORKS QUALITY ASSURANCE CERTIFICATE



Client: _____
Project: _____
Project No: _____
Contractor: _____

Shire of Denmark
953 South Coast Highway
(PO Box 183), Denmark WA 6333
Phone: (08) 9848 0300 ABN: 24 355 062 623
Email: enquiries@denmark.wa.gov.au
Website: www.denmark.wa.gov.au

1. TOPSOIL STRIPPING

1.1 Area of topsoil removed to stockpile _____
1.2 Approximate quantity of topsoil removed _____ m²
1.3 Completion date of topsoil stripping Date: _____
Contractor Verification _____ Date: _____

2. FINISHED EARTHWORKS LEVELS

Contractor to provide as-constructed survey of earthworks area.
Contractors Surveyor _____ Date: _____
Lodged with Superintendent _____ Date: _____
Contractor Verification _____ Date: _____

3. COMPACTION TESTING OF EARTHWORKS AREA

Contractor to complete compaction form attached in Appendix 2
Lodged with Superintendent _____ Date: _____

4. STABILISATION

4.1 Topsoil Replacement
• Average depth of topsoil placement _____ mm
• Completion date of topsoil placement Date: _____

4.2 Hydromulch
• Mix details: _____

Application rate: _____ Kg/ha Area Seeded: _____ m²
Commencement date: _____ Completion date: _____

4.3 GLUON 240 Spray
Application rate: _____ Kg/ha
Commencement date: _____ Completion date: _____

4.4 Direct Seeding
• Mix details: _____

Application rate: _____ Kg/ha Area Seeded: _____ m²
Commencement date: _____ Completion date: _____

Marked up plan with areas shown
Contractor Verification _____ Date: _____

EARTHWORKS COMPACTION TESTING RESULTS



Shire of Denmark
 953 South Coast Highway
 (PO Box 183), Denmark WA 6333
 Phone: (08) 9848 0300 ABN: 24 355 062 623
 Email: enquiries@denmark.wa.gov.au
 Website: www.denmark.wa.gov.au

Client: _____
 Project: _____
 Project No: _____
 Contractor: _____

Location RL:	No:	Location RL:	No:	Location RL:	No:	Location RL:	No:
D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s
0 - 1 5 0	S e a t i n g	0 - 1 5 0	S e a t i n g	0 - 1 5 0	S e a t i n g	0 - 1 5 0	S e a t i n g
1 5 0 - 4 5 0		1 5 0 - 4 5 0		1 5 0 - 4 5 0		1 5 0 - 4 5 0	
4 5 0 - 7 5 0		4 5 0 - 7 5 0		4 5 0 - 7 5 0		4 5 0 - 7 5 0	
7 5 0 - 1 0 5 0		7 5 0 - 1 0 5 0		7 5 0 - 1 0 5 0		7 5 0 - 1 0 5 0	
1 0 5 0 - 1 3 5 0		1 0 5 0 - 1 3 5 0		1 0 5 0 - 1 3 5 0		1 0 5 0 - 1 3 5 0	

EARTHWORKS COMPACTION TESTING RESULTS



1		1		1		1	
3		3		3		3	
5		5		5		5	
0		0		0		0	
-		-		-		-	
1		1		1		1	
6		6		6		6	
5		5		5		5	
0		0		0		0	

Location RL:	No:	Location RL:	No:	Location RL:	No:	Location RL:	No:
D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s
0 - 1 5 0	S e a t i n g	0 - 1 5 0	S e a t i n g	0 - 1 5 0	S e a t i n g	0 - 1 5 0	S e a t i n g
1 5 0 - 4 5 0		1 5 0 - 4 5 0		1 5 0 - 4 5 0		1 5 0 - 4 5 0	
4 5 0 - 7 5 0		4 5 0 - 7 5 0		4 5 0 - 7 5 0		4 5 0 - 7 5 0	
7 5 0 - 1 0 5 0		7 5 0 - 1 0 5 0		7 5 0 - 1 0 5 0		7 5 0 - 1 0 5 0	
1 0 5 0 - 1		1 0 5 0 - 1		1 0 5 0 - 1		1 0 5 0 - 1	

EARTHWORKS COMPACTION TESTING RESULTS



3		3		3		3	
5		5		5		5	
0		0		0		0	
1		1		1		1	
3		3		3		3	
5		5		5		5	
0		0		0		0	
-		-		-		-	
1		1		1		1	
6		6		6		6	
5		5		5		5	
0		0		0		0	

Location RL:	No:	Location RL:	No:	Location RL:	No:	Location RL:	No:
D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s	D e p t h (m m)	N u m b e r o f B l o w s
0	S e a t i n g	0	S e a t i n g	0	S e a t i n g	0	S e a t i n g
-		-		-		-	
1		1		1		1	
5		5		5		5	
0		0		0		0	
-		-		-		-	
4		4		4		4	
5		5		5		5	
0		0		0		0	
-		-		-		-	
7		7		7		7	
5		5		5		5	
0		0		0		0	
-		-		-		-	
1		1		1		1	
0		0		0		0	
5		5		5		5	

EARTHWORKS COMPACTION TESTING RESULTS



0		0		0		0	
-		-		-		-	
1		1		1		1	
3		3		3		3	
5		5		5		5	
0		0		0		0	
1		1		1		1	
3		3		3		3	
5		5		5		5	
0		0		0		0	
-		-		-		-	
1		1		1		1	
6		6		6		6	
5		5		5		5	
0		0		0		0	

Contractor Verification _____ Date: _____

NOTE: All earthworks compaction testing results to be accompanied by plan showing test location number

COMPACTION TEST CERTIFICATE



Shire of Denmark
 953 South Coast Highway
 (PO Box 183), Denmark WA 6333
 Phone: (08) 9848 0300 ABN: 24 355 062 623
 Email: enquiries@denmark.wa.gov.au
 Website: www.denmark.wa.gov.au

Client: _____
 Project: _____
 Project No: _____
 Contractor: _____

Site Plan:

Location: _____
 Date: _____
 Tested By: _____ Time: _____

Depth (mm)	Number of Blows								
	1	2	3	4	5	6	7	8	9
0-150	Seating	Seating	Seating	Seating	Seating	Seating	Seating	Seating	Seating
150-450									
450-750									
750-1050									
1050-1350									
1350-1650									

Comments:

Contractor Verification _____ Date: _____

STORMWATER DRAINAGE AS CONSTRUCTED DATA



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 Email: enquiries@denmark.wa.gov.au
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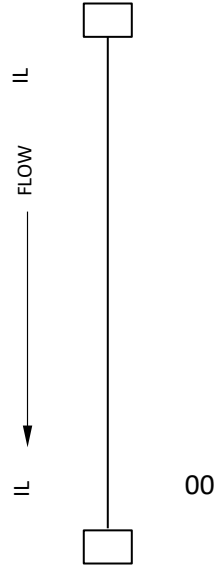
Client: _____
 Project: _____
 Project No: _____
 Contractor: _____

Access chamber location sketch (show boundaries):

MANHOLE/GULLY No: _____
 RL Cover: _____
 Type of Manhole/Gully: _____
 Type of Cover: _____

DRAIN LINE
 Diameter _____
 Grade _____
 Material & Class _____
 Type of Joint _____
 Type of Excavation _____

MANHOLE/GULLY No: _____



Bedding Details	Subsoil Details	Property Connection Distance

Licensed Surveyor: _____

Date: _____

(FOR LOCATION, PIPE IL's, COVER RL's, ACCESS CHAMBER DISTANCES)

STORMWATER DRAINAGE



COMPACTION CERTIFICATE

Client: _____
 Project: _____
 Project No: _____
 Contractor: _____

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 Website: www.denmark.wa.gov.au

Location: _____
 Date Tested: _____
 Tested By: _____

Penetrometer Resistance – Perth Sand Penetrometer (AS1289F3.3)

Penetrometer Calibration: _____

Soil Type: _____ Moisture Condition: _____
 NSL of Test: 1. _____ 2. _____ 3. _____

(show test locations)

Depth (mm)	Number of Blows		
	1	2	3
0-150	1	2	3
150-450	Seating	Seating	Seating
450-750			
750-1050			
1050-1350			
1350-1650			
1650-1950			
1950-2250			

MH:
 No:
 IL:
 Lid Level:

MH:
 No:
 IL:
 Lid Level:

ROADWORKS QUALITY ASSURANCE CERTIFICATE



Client: _____
 Project: _____
 Project No: _____
 Contractor: _____

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 Website: www.denmark.wa.gov.au

1. SUBGRADE	
1.1	Removal of unsuitable material (Location to be shown on marked plan) Yes / No
1.2	As-constructed: Levels checked by _____ Date: _____ Plan of levels supplied _____ Yes / No _____ Date: _____ Alignment checked by _____ Date: _____ Box width checked by _____ Date: _____
1.3	Subgrade Compaction: Testing completed by: _____ Date: _____ Results lodged with Superintendent: _____ Date: _____
Contractor's Signature: _____ Date: _____ Position: _____	

2. SUB-BASE	
2.1	Material Specification: Supplier's Compliance Certificate lodged with Superintendent _____ Date: _____
2.2	As-constructed: Levels checked by _____ Date: _____ Alignment checked by _____ Date: _____ Width checked by _____ Date: _____ Depth of: _____ mm Checked by _____ Date: _____
2.3	Sub-base Compaction: Testing completed by: _____ Date: _____ Lodged with Superintendent: _____ Date: _____
Contractor's Signature: _____ Date: _____ Position: _____	

ROADWORKS QUALITY ASSURANCE CERTIFICATE



3. BASE-COURSE	
3.1	Material Specification: Supplier's Compliance Certificate lodged with Superintendent _____ Date: _____
3.2	As-constructed: Levels checked by _____ Date: _____ Alignment checked by _____ Date: _____ Width checked by _____ Date: _____ Depth of: _____ mm Checked by _____ Date: _____
3.3	Base-course Compaction: Testing completed by: _____ Date: _____ Lodged with Superintendent: _____ Date: _____
Contractor's Signature: _____ Date: _____ Position: _____	

4. BASE-COURSE																	
4.1	Material Specification: Supplier's Compliance Certificate lodged with Superintendent _____ Date: _____																
4.2	Bitumen Application: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 20%; text-align: center;">1</th> <th style="width: 20%; text-align: center;">2</th> <th style="width: 30%; text-align: center;">Specification</th> </tr> </thead> <tbody> <tr> <td>Rate of application</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Bitumen temperature</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Area sprayed</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		1	2	Specification	Rate of application				Bitumen temperature				Area sprayed			
	1	2	Specification														
Rate of application																	
Bitumen temperature																	
Area sprayed																	
4.3	Cover Application: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 20%; text-align: center;">1</th> <th style="width: 20%; text-align: center;">2</th> <th style="width: 30%; text-align: center;">Specification</th> </tr> </thead> <tbody> <tr> <td>Rate of application</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Size & type of aggregate</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		1	2	Specification	Rate of application				Size & type of aggregate							
	1	2	Specification														
Rate of application																	
Size & type of aggregate																	
4.4	Plan of Levels Supplied: _____ Yes / No _____ Date: _____																
Contractor's Signature: _____ Date: _____ Position: _____																	

ROADWORKS QUALITY ASSURANCE CERTIFICATE



5. KERBING	
5.1	<p>Material Specification Supplier's Compliance Certificate lodged with Superintendent Date: _____ Completion date of topsoil stripping Date: _____</p>
5.2	<p>As-Constructed: Width between kerbs: Checked by: _____ Date: _____ Construction joint spacing: Checked by: _____ Date: _____ Contraction joint spacing: Checked by: _____ Date: _____</p>
5.3	<p>Type of curing used: _____ Date curing applied: _____</p>
<p>Contractor's Signature: _____ Date: _____ Position: _____</p>	

6. AC SEAL		YES / NO																				
6.1	<p>Material Specification: Supplier's Compliance Certificate lodged with Superintendent Date: _____</p>																					
6.2	<p>AC Application:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 30%;"></th> <th style="width: 15%; text-align: center;">1</th> <th style="width: 15%; text-align: center;">2</th> <th style="width: 30%; text-align: left;">Specification</th> </tr> </thead> <tbody> <tr> <td>Actual quantity supplied</td> <td style="height: 30px;"></td> <td style="height: 30px;"></td> <td></td> </tr> <tr> <td>Thickness laid</td> <td style="height: 30px;"></td> <td style="height: 30px;"></td> <td></td> </tr> <tr> <td>Temperature of initial rolling</td> <td style="height: 30px;"></td> <td style="height: 30px;"></td> <td></td> </tr> <tr> <td>Density of compacted layer</td> <td style="height: 30px;"></td> <td style="height: 30px;"></td> <td></td> </tr> </tbody> </table>		1	2	Specification	Actual quantity supplied				Thickness laid				Temperature of initial rolling				Density of compacted layer				
	1	2	Specification																			
Actual quantity supplied																						
Thickness laid																						
Temperature of initial rolling																						
Density of compacted layer																						
6.3	<p>Ponding checked by _____ Date: _____</p>																					
6.4	<p>Plan of Levels Supplied: Yes / No Date: _____</p>																					
<p>Contractor's Signature: _____ Date: _____ Position: _____</p>																						

ROADWORKS QUALITY ASSURANCE CERTIFICATE



7. BLOCK PAVING	YES / NO
7.1 Material Specification: Supplier's Compliance Certificate lodged with Superintendent Date: _____	
7.2 Sand Quality: Bedding sand grading curve lodged with Superintendent Date: _____ Joint filling sand grading curve lodged with Superintendent Date: _____	
7.3 Ponding checked by: _____ Date: _____	
7.4 Accelerated Loading: Contractor's Certificate lodged with Superintendent Date: _____	
Contractor's Signature: _____ Date: _____ Position: _____	

8. STREET SIGNS	YES / NO
8.1 Footing to Each Post: Checked by: _____ Date: _____ Actual minimum size of footings _____ x _____ x _____	
8.2 Colour and Lettering Style Complies with Shire Standard: Checked by: _____ Date: _____	
Contractor's Signature: _____ Date: _____ Position: _____	

ROADWORKS MATERIAL SPECIFICATION



Client: _____
Project: _____
Project No: _____
Contractor: _____

Shire of Denmark
953 South Coast Highway
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Website: www.denmark.wa.gov.au

LATERITE GRAVEL BASECOURSE

Material Property	Measured Value	Specified Requirement	Comments
Liquid Limit		Not Greater than 25	
Plastic Limit		Not Specified	
Plasticity Index		2 - 6	
Linear Shrinkage		Not greater than 2%	
Dry compressive strength		Not less than 2MPa	

Date of Suppliers Certificate: _____

Copy to be attached along with:
• grading results

ROADWORKS MATERIAL SPECIFICATION



Client: _____
Project: _____
Project No: _____
Contractor: _____

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LIMESTONE RUBBLE SUB-BASE

Material Property	Measured Value	Specified Requirement	Comments
Calcium Carbonate		60 – 80%	
Percentage of Wear (Los Angeles Test)		Not greater than 60% weight loss	
Maximum Dry Compressive Strength		Not less than 700kPa	

Date of Suppliers Certificate: _____

- Copy to be attached along with:
- grading results

ROADWORKS MATERIAL SPECIFICATION



Client: _____
Project: _____
Project No: _____
Contractor: _____

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ASPHALTIC CONCRETE

Material Property	Measured Value	Specified Requirement	Comments
Bitumen Content		5 – 7%	
Marshall Stability		Not less than 5.5KN	
Marshall Flow Value		2 – 4mm	
Percentage Voids		3 – 5%	

Date of Suppliers Certificate: _____

Copy to be attached along with:

- grading results
- confirmation of rolling procedure
- certification of ponding check

ROADWORKS MATERIAL SPECIFICATION



Client: _____
Project: _____
Project No: _____
Contractor: _____

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CONCRETE FOR KERB CONSTRUCTION

Material Property	Measured Value	Specified Requirement	Comments
28 Day Characteristic Strength		25 MPa	
Slump		50mm	
Maximum Aggregate Size		10mm	
Curing Agent			

Date of Suppliers Certificate: _____

ROADWORKS MATERIAL SPECIFICATION



Client: _____
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CRUSHED ROCK BASECOURSE

Material Property	Measured Value	Specified Requirement	Comments
Liquid Limit		Not Greater than 25	
Plastic Limit		Not Specified	
Plasticity Index		2 - 5	
Linear Shrinkage		Not greater than 2%	
Dry compressive strength		Not less than 2MPa	

Date of Suppliers Certificate: _____

Copy to be attached along with:

- grading results

ROADWORKS MATERIAL SPECIFICATION



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953 South Coast Highway
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Website: www.denmark.wa.gov.au

Client: _____
Project: _____
Project No: _____
Contractor: _____

BLOCK PAVING UNITS

Date of Suppliers Certificate: _____

Copy to be attached along with:

- grading curve for bedding sand
- grading curve for jointing sand
- certification of ponding check