1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide plain or reinforced concrete base, as documented.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of Traffic.
- 1121 Open drains, including kerb and gutter.
- 1132 Lean mix concrete subbase.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used

Australian standards

AS 1012 Methods of testing concrete
AS 1012.1 Sampling of fresh concrete
AS 1012.3.1 Determination of properties related to the consistency of concrete - Slump test
AS 1012.3.3 Determination of properties related to the consistency of concrete - Vebe test
AS 1012.4.2 Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1 Method for making and curing concrete - Compression and indirect tensile test specimens
AS 1012.9 Determination of the compressive strength of concrete specimens
AS 1012.12.2 Determination of mass per unit volume of hardened concrete - Water displacement method
AS 1012.13 Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory
AS 1012.14 Method for securing and testing cores from hardened concrete for compressive strength
AS 1141 Methods for sampling and testing aggregates
AS 1141.11.1 Particle size distribution - sieving method
AS 1141.12 Materials finer than 75 micrometre in aggregates (by washing)
AS 1141.14 Particle shape, by proportional calliper
AS 1141.18 Crushed particles in coarse aggregate derived from gravel
AS 1141.22 Wet/dry strength variation
AS 1141.24 Aggregate soundness - Evaluation by exposure to sodium sulfate solution
AS 1160 Bituminous emulsions for the construction and maintenance of pavements
AS 1289 Methods of testing soils for engineering purposes
AS 1289.4.2.1 Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1379 Specification and supply of concrete
AS 1478 Chemical admixtures for concrete, mortar and grout
AS 1478.1 Admixtures for concrete
AS/NZS 1554 Structural steel welding
AS/NZS 1554.3 Welding of reinforcing steel
AS 2758  Aggregates and rock for engineering purposes
AS 2758.1  Concrete aggregates
AS 3582  Supplementary cementitious materials for use with portland and blended cement
AS 3582.1  Fly ash
AS 3583  Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13  Determination of chloride ion content
AS 3600  Concrete structures
AS 3799  Liquid membrane—forming curing compounds for concrete
AS 3972  General purpose and blended cements
AS/NZS 4671  Steel reinforcing materials
AS/NZS 4680  Hot-dipped galvanized (zinc) coatings on fabricated ferrous articles
SAA HB 155  Guide to the use of recycled concrete and masonry materials
Australroads
AGPT04C  Guide to pavement technology part 4C: Materials for concrete road pavements
AGPT04E  Guide to pavement technology part 4E: Recycled materials
AGPT04J  Guide to pavement technology part 4J: Aggregate and source rock
AGPT08  Guide to pavement technology part 8: Pavement construction

Other publications
Note: Only the most current standards are to be used

NSW RMS Test Methods
T 240  Road surface texture depth (sand patch)
T 1160  Low temperature recovery of preformed polychloroprene elastomeric joint seals for bridge structures
T 1161  High temperature recovery of polychloroprene elastomeric joint seals for bridge structures
T 1163  Resistance of vulcanised rubber to the absorption of oil
T 1192  Adhesion of sealant
T 1193  Accelerated Aging of cured sealant
ASTM Standards
C793  Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants
C794  Standard test method for adhesion-in-peel of elastomeric joint sealants
D792  Standard test methods for density and specific gravity (relative density) of plastics by displacement
D2240  Standard test method for rubber property-durometer hardness
D2628  Standard specification for preformed polychloroprene elastomeric joint seals for concrete pavements
D2835  Standard specification for lubricant for installation of preformed compression seal in concrete pavements

US Military Specifications
SAE AMS-S - 8802  Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion

1.4 STANDARDS

General
Standard: To AS 1379, AS 3600, AGPT08 and AGPT04C.

1.5 INTERPRETATIONS

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- JRCP: Jointed reinforced concrete.
- PCP: Jointed plain concrete.

Definitions
General: For the purposes of this worksection the following definitions apply:
- Lot: A continuous placement of up to 50 m³ of subbase concrete.
- Nominated mix: Proposed concrete mix after the approval.

1.6 HOLD POINTS AND WITNESS POINTS

**Approval**
Submissions: To the Superintendent's approval.

**Notice**
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

### HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause title / Item</th>
<th>Requirement</th>
<th>Notice of inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESIGN AND CONTROL OF CONCRETE MIX</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominated mix</td>
<td>Submit details and certificates for nominated concrete mix and material constituents</td>
<td>21 working days before ordering concrete</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>SITE ESTABLISHMENT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subbase survey</td>
<td>Work-as-executed survey of the subbase.</td>
<td>2 working days before starting any works</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>TRIAL CONCRETE BASE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Obtain approval for the trial section</td>
<td>5 working days before main works</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Deficient trial section</td>
<td>Review of deficiencies in the trial section</td>
<td>2 working days after construction</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Non-conforming trial section</td>
<td>If trial section does not conform then remove and replace</td>
<td>5 working days before main works</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>SLAB ANCHORS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation</td>
<td>Submit compacted excavated surface</td>
<td>1 working day before concreting</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>INSTALLATION OF STEEL REINFORCEMENT</strong></td>
<td>Approval of placement and fastening of reinforcing steel</td>
<td>4 working hours before concrete placement</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Placing and cover requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE</strong></td>
<td>Submit proposed methods and equipment</td>
<td>4 weeks before starting</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Concrete production and transport</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PLACING AND FINISHING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment and methods</td>
<td>Submit full details of proposed placing and finishing methods together with a paving plan</td>
<td>4 weeks before starting</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Surface texture</td>
<td>Submit details of proposed texturing device and method of texturing</td>
<td>Before texturing</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>JOINTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent sealing</td>
<td>Submit proposed method for permanent joint sealing</td>
<td>4 weeks before installation</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Clause title / Item</th>
<th>Requirement</th>
<th>Notice of inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling</td>
<td>Inspection of sampling procedure</td>
<td>Progressive</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Acceptance criteria</td>
<td>Submit test results</td>
<td>Progressive</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Acceptance criteria for cored concrete</td>
<td>Submit test results</td>
<td>Progressive</td>
<td>Superintendent</td>
</tr>
<tr>
<td>REMOVAL AND REPLACEMENT OF BASE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Submit proposed method of removal to preserve adjoining base and underlying subbase</td>
<td>7 working days before replacement works</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table – Off site activities**

<table>
<thead>
<tr>
<th>Clause/ subclause</th>
<th>Requirement</th>
<th>Notice of inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEEL REINFORCEMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Provide NATA certificates and manufacturer's information.</td>
<td>Before delivering to site</td>
</tr>
<tr>
<td>Bar chairs</td>
<td>Demonstrate load bearing capacity</td>
<td>Before delivering to site</td>
</tr>
<tr>
<td>SEALANTES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Provide NATA certificate and manufacturer's information</td>
<td>4 weeks before joint work</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table – On site activities**

<table>
<thead>
<tr>
<th>Clause/ subclause</th>
<th>Requirement</th>
<th>Notice of inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage and transport</td>
<td>Re-test cement stored for longer than 3 months</td>
<td>Progressive</td>
</tr>
<tr>
<td>AGGREGATES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>Storage and handling to preserve quality of aggregate</td>
<td>Progressive</td>
</tr>
<tr>
<td>SLAB ANCHORS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Locations as shown on drawings</td>
<td>Progressive</td>
</tr>
<tr>
<td>PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete delivery</td>
<td>Keep record of delivery information</td>
<td>Progressive</td>
</tr>
<tr>
<td>PLACING AND FINISHING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment and methods</td>
<td>Notice of planned start on site</td>
<td>7 working days before starting on site</td>
</tr>
<tr>
<td>Consistency</td>
<td>Provide slump check test results</td>
<td>Progressive</td>
</tr>
<tr>
<td>Ambient conditions</td>
<td>Provide details of protection methods for cold or hot weather and rain</td>
<td>Progressive</td>
</tr>
<tr>
<td>Evaporation and moisture loss</td>
<td>Provide details of precautionary measures to prevent moisture loss when evaporation rate exceeds prescribed limits</td>
<td>Progressive</td>
</tr>
<tr>
<td>Clause/ subclause</td>
<td>Requirement</td>
<td>Notice of inspection</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Paving in general</td>
<td>Construction joint if hand or mechanical paving is disrupted</td>
<td>Progressive</td>
</tr>
<tr>
<td>Assessment of base thickness</td>
<td>Survey of base surface, edge alignment and thickness</td>
<td>3 working days after placement</td>
</tr>
<tr>
<td>Traffic considerations</td>
<td>Provide traffic management measures</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

JOINTS

| Location                          | Locations as shown on drawings or as directed                              | Before works         |

CURING

| Application method                | Check curing compound application rate                                    | Progressive          |

TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH

| Testing of specimens cut from the work | Carry out coring in presence of the Superintendent                        |                       |
| Remedial work after coring           | Restore holes with non-shrink cementitious concrete                         | After coring          |

RELATIVE COMPACTATION OF CONCRETE

| Testing for relative compaction     | Remove and replace non-conforming base                                      | Progressive          |

2 PRE-CONSTRUCTION PLANNING

2.1 ACTIVITY PLAN

General

Program: Plan the following activities:
- Provide planning resources to allocate plant and personnel for the contract period.
- Program the work to meet the constraints of HOLD POINTS, WITNESS POINTS.
- Plan work to make sure that where jointed concrete shoulders are specified, the plain and reinforced concrete base is constructed first.

2.2 DESIGN AND CONTROL OF CONCRETE MIX

Nominated mix

General: Before starting the production of the concrete for base works, carry out a trial mix to certify the conformance of the proposed concrete mix.

Testing authority: NATA registered laboratory.

Submission requirements:
- Details of all material constituents and test reports to the MATERIALS clause and the following:
  - Cement: Brand and source.
  - Fly ash: Powerhouse source.
  - Admixtures: Proprietary source, type, name and dosage recommended by manufacturer.
  - Aggregates: Source, geological type, moisture condition, proportions and grading for each type and the grading for the combined aggregate.
  - Curing compounds: Application rate.
- Concrete mix design.
- Test results and certificates of conformance for the concrete mix:
  - Standard: To AS 1379.
  - Acceptance criteria: To CONCRETE QUALITY REQUIREMENTS.

Submission type: HOLD POINT.
Pre-approved mix
Identical mix: To avoid testing the nominated mix, submit results from earlier testing of a mix identical with the nominated mix for approval.
Pre-approval: A mix may be pre-approved under the following conditions:
- If the mix was used in a separate contract within 12 months of the proposed works date.
- If fully approved details have been previously used.
- If the constituent materials and quality remain unchanged from those previously approved.
- If the in-service performance of the concrete incorporating the nominated mix is acceptable.

Variations to nominated mix and materials
Approval: Submit details of any changes to the nominated mix, its method of production or source of supply of constituents.
Non-conformance: Consider any change made without approval to a material in the approved mix as a non-conforming material. Concrete containing this material may become non-conforming.

2.3 SITE ESTABLISHMENT

General
General: Provide the following:
- Personnel, plant, equipment, components and materials.
- On site and off site facilities.
- Liaison with authorities.
- Safety procedures.

3 MATERIALS

3.1 CEMENT

General
Standard: To AS 3972.

Storage and transport
Storage time: Re-test cement that has been stored for more than three months from the time of manufacture. Cost of re-testing to be borne by the Contractor.
Inspection type: WITNESS POINT.
Transport: Transport cement in watertight packaging and protect from moisture. Do not use caked or lumpy cement.

3.2 FLYASH

General
Standard: To AS 3582.1.

3.3 WATER

General
Standard: AS 1379.
Requirement: Clean, free from oil, acid, alkali, organic or vegetable matter.
Limits: Conform to the following:
- Maximum 300 parts per million of chloride ion, as determined to AS 3583.13.
- Maximum 400 parts per million of sulfate ion, as determined to AS 1289.4.2.1.

3.4 ADMIXTURES

General
Standard: To AS 1478.1.
Requirement: Provide admixtures free from calcium chloride, calcium formate, or triethanolamine or any other accelerator.
Dosage: Vary the dosage of chemical admixture to account for air temperature and setting time in conformance with the manufacturer's recommendations.
Compatibility of admixtures: Provide certification from the manufacturer for combinations of two or more admixtures.

**Types of admixtures**

Warm season retarder: During the warm season, (October to March inclusive), use a lignin or lignin-based ('lignol') set-retarding admixture (Type Re or Type WRRe) to control slump within the limits stated in **CONCRETE QUALITY REQUIREMENTS, Consistency**.

Cool season retarder: During the cool season, (April to September inclusive), use only a lignin or lignin based set-retarding admixture containing not more than 6 % reducing sugars (Type WRRe conforming to AS 1478.1).

### 3.5 AGGREGATES

**General**

Standards: AS 2758.1 and AGPT04J.

**Recycled concrete aggregate**

Coarse aggregates from demolition concrete: To the recommendations of SAA HB155 and Austroads AGPT04E.

Blending: If blending coarse recycled concrete aggregate with natural aggregates, make sure substitution rates are below 30%.

Concrete mix proposed for slipforming: Conform to the **Combined aggregate grading table**.

**Combined aggregate grading table**

<table>
<thead>
<tr>
<th>Australian Standard sieve</th>
<th>% passing by mass of sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.00 mm</td>
<td>95–100</td>
</tr>
<tr>
<td>9.50 mm</td>
<td>55–75</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>36–48</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>30–42</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>22–34</td>
</tr>
<tr>
<td>600 μm</td>
<td>16–27</td>
</tr>
<tr>
<td>300 μm</td>
<td>5–12</td>
</tr>
<tr>
<td>150 μm</td>
<td>0–3</td>
</tr>
<tr>
<td>75 μm</td>
<td>0–2</td>
</tr>
</tbody>
</table>

**Fine aggregate**

Properties:
- Size: Max 4.75 mm.
- Water absorption: 5% maximum.
- Quartz sand content for pavements without asphalt surfacing: Provide at least 40% by mass of the total aggregates in the concrete mix of quartz sand, containing minimum 70% quartz, by mass.

Quality requirement: Clean, hard, tough, durable, uniform, uncoated grains.

Sodium sulfate soundness: To AS 1141.24 and not to exceed the limits shown in the **Sodium sulfate soundness limits table**.

**Sodium sulfate soundness limits table**

<table>
<thead>
<tr>
<th>Australian Standard Sieve</th>
<th>% Loss by mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.75 mm to 2.36 mm</td>
<td>4</td>
</tr>
<tr>
<td>2.36 mm to 1.18 mm</td>
<td>6</td>
</tr>
<tr>
<td>1.18 mm to 600 μm</td>
<td>8</td>
</tr>
<tr>
<td>600 μm to 300 μm</td>
<td>12</td>
</tr>
</tbody>
</table>

Blending of two or more fine aggregates: To the **Sodium sulfate soundness limits table** for each constituent material.

Grading: To AS 1141.11.1 and within the limits shown in the **Fine aggregate grading table**.
Fine aggregate grading table

<table>
<thead>
<tr>
<th>Australian Standard sieve</th>
<th>Proportion passing (% of mass of sample)</th>
<th>Deviation from proposed grading (% of mass of sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.50 mm</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>90–100</td>
<td>± 3</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>65–95</td>
<td>± 10</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>40–80</td>
<td>± 10</td>
</tr>
<tr>
<td>600 μm</td>
<td>24–52</td>
<td>± 10</td>
</tr>
<tr>
<td>300 μm</td>
<td>8–25</td>
<td>± 5</td>
</tr>
<tr>
<td>150 μm</td>
<td>1–8</td>
<td>± 2</td>
</tr>
<tr>
<td>75 μm</td>
<td>0–3</td>
<td>-</td>
</tr>
</tbody>
</table>

Coarse aggregate

Quality requirements: Clean, crushed, hard durable rock, metallurgical furnace slag or gravel. If required, wash coarse aggregates.

Properties: Conform to the Coarse aggregate properties table.

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification limits</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water absorption</td>
<td>2.5 % max</td>
<td>AS 1141.6.1</td>
</tr>
<tr>
<td>Material finer than 75 micrometers</td>
<td>1 % max</td>
<td>AS 1141.12</td>
</tr>
<tr>
<td>Wet strength</td>
<td>≥ 80 kN</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td>Wet/dry strength variation</td>
<td>≤ 35%</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td>Soundness—loss in mass</td>
<td>≤ 9.0%</td>
<td>AS 1141.24</td>
</tr>
<tr>
<td>Misshapen particles (2:1 ratio)</td>
<td>≤ 35%</td>
<td>AS 1141.14</td>
</tr>
<tr>
<td>Fractured faces (two or more)</td>
<td>≥ 80%</td>
<td>AS 1141.18</td>
</tr>
</tbody>
</table>

Grading: To AS 1141.11.1 and within the limits shown in the Coarse aggregate grading table.

<table>
<thead>
<tr>
<th>Australian Standard sieve</th>
<th>Proportion passing (% of mass of sample)</th>
<th>Deviation from proposed grading (% of mass of sample)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.50 mm</td>
<td>100</td>
<td>-</td>
</tr>
<tr>
<td>19.00 mm</td>
<td>95–100</td>
<td>± 2</td>
</tr>
<tr>
<td>13.20 mm</td>
<td>(accepted design mix)</td>
<td>± 5</td>
</tr>
<tr>
<td>9.50 mm</td>
<td>25–55</td>
<td>± 5</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>0–10</td>
<td>± 3</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>0–2</td>
<td>-</td>
</tr>
</tbody>
</table>

Storage

Storage areas: Locate the storage area to prevent segregation and mixing of the aggregates with foreign materials.

Inspection type: WITNESS POINT.

3.6 STEEL REINFORCEMENT

General

Standards: To AS/NZS 4671 and AGPT04C clause 5.

Certification: Provide NATA test certificates for the steel reinforcement to AS 4671.

Activity type: WITNESS POINT.

Grade, type and size: As shown on the drawings.

Surface condition: Free from loose mill scale, rust, grease, mud, mortar or any other material which would reduce the bond between the reinforcement and the concrete.

Galvanised bars: Hot-dipped to AS/NZS 4680.

Cold-worked reinforcing bars: Do not use.
Tie wire: Annealed iron wire with minimum 1.25 mm diameter.

Bar chairs
General: Provide plastic bar chairs or plastic tipped wire chairs, capable of withstanding a load of 200 kg mass on the chair for one hour at 23 ± 5°C.
Inspection type: WITNESS POINT.

3.7 SEALANTS

General
Certification: Provide certificate from a NATA registered laboratory.
Manufacturer information: Provide evidence confirming compatible fit and suitability for designed joint dimensions and proposed method.
Inspection type: WITNESS POINT.
Silicon joint sealants: To Silicone joint sealant requirements table.

Silicone joint sealant requirements table

<table>
<thead>
<tr>
<th>Test method</th>
<th>Test</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM-D792</td>
<td>Specific Gravity</td>
<td>1.1 to 1.55</td>
</tr>
<tr>
<td>SAE AMS-S-8802</td>
<td>Extrusion Rate</td>
<td>90 to 250 g per min</td>
</tr>
<tr>
<td>SAE AMS-S-8802</td>
<td>Tack Free Time</td>
<td>30 to 70 min</td>
</tr>
<tr>
<td>ASTM D2240</td>
<td>Durometer</td>
<td>10 to 25</td>
</tr>
<tr>
<td>RMS T1192</td>
<td>Durability: Extension</td>
<td>To 70%</td>
</tr>
<tr>
<td>RMS T1193</td>
<td>Durability: Compression</td>
<td>To 50%</td>
</tr>
<tr>
<td>ASTM C794</td>
<td>Adhesion to Concrete</td>
<td>35 N minimum average peel strength</td>
</tr>
<tr>
<td>ASTM C793</td>
<td>Accelerated Weathering at 5,000 hours</td>
<td>No cracks, blisters or bond loss</td>
</tr>
<tr>
<td>N.A.</td>
<td>Colour</td>
<td>Grey, compatible with pavement concrete</td>
</tr>
</tbody>
</table>

Neoprene joint sealants: To ASTM D2628, NSW RMS Test Methods T1160, T1161 and T1163 or relevant State Road Authority requirements.

3.8 CURING COMPOUNDS

General
Efficiency index: Minimum 90% when tested to AS 3799 Appendix B.

Alternative curing compounds

<table>
<thead>
<tr>
<th>Type</th>
<th>Suitability with bituminous / asphaltic surfaced</th>
<th>Wearing surface</th>
<th>No wearing surface</th>
<th>Base type</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5 hydrocarbon resin compound conforming to AS 3799 Class B and with no aromatic hydrocarbon additions. *</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water borne hydrocarbon resin or styrene butadiene resin (SBR) conforming with AS 3799 Class Z. *</td>
<td>Yes</td>
<td></td>
<td>JRCP</td>
<td></td>
</tr>
<tr>
<td>Bitumen emulsion grade CRS/170 conforming to AS 1160. *</td>
<td>Yes</td>
<td>Yes</td>
<td>JRCP</td>
<td></td>
</tr>
<tr>
<td>White pigmented wax emulsion Class A Type 2. *</td>
<td>Yes</td>
<td></td>
<td>PCP, JRCP</td>
<td></td>
</tr>
<tr>
<td>Debonding treatment bitumen seal with 5-7mm aggregate</td>
<td>Yes</td>
<td>Yes</td>
<td>PCP, JRCP</td>
<td></td>
</tr>
</tbody>
</table>
3.9 CONCRETE QUALITY REQUIREMENTS

General
Standard: To AS 3600 and AS 1379.

Concrete properties
Requirements: Conform to the Concrete properties table.

Concrete properties table

<table>
<thead>
<tr>
<th>Properties</th>
<th>Quality requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum cement content</td>
<td>270 kg/m$^3$ of concrete</td>
</tr>
<tr>
<td>Minimum flyash content</td>
<td>50 kg/m$^3$ of concrete</td>
</tr>
<tr>
<td>Minimum compressive strength at 28 days (AS 1012.9)</td>
<td>35 MPa</td>
</tr>
<tr>
<td>Drying shrinkage of nominated mix (AS 1012.13) at the nominated slump $\pm$ 10 mm</td>
<td>$&lt; 450 \mu e$ after 21 days of air drying average of readings within 5% of the median of the three readings</td>
</tr>
<tr>
<td>Consistency (Slump to AS 1012.3.1)</td>
<td>30 mm - 40 mm for mechanically placed concrete</td>
</tr>
<tr>
<td>Air content (To AS 1012.4.2)</td>
<td>55 mm - 65 mm for hand placed concrete</td>
</tr>
<tr>
<td>Air content (To AS 1012.4.2)</td>
<td>4% - 7% when discharged from the transport vehicle ready for placement</td>
</tr>
<tr>
<td>Minimum relative compaction (To AS 1012.12.2)</td>
<td>98%</td>
</tr>
</tbody>
</table>

Testing of concrete properties
Sampling and testing for compressive strength: To TESTING OF CONCRETE FOR COMpressive STRENGTH.
Testing for drying shrinkage: To AS 1012.13 and the following:
- Perform shrinkage tests on every 150 m$^3$ of concrete poured or one day's production.
- Average: Take the drying shrinkage at the nominated slump $\pm$10 mm as the average of all readings within 30 $\mu e$ of the median value.

Testing for consistency:
- Slump: To AS 1012.3.1.
- Vebe time reading for slipform concrete mix: Maximum of 3 seconds at the nominated slump less 10 mm when tested to AS 1012.3.3.

Testing for air content: To AS 1012.4.2. If the measured air content is not within the limits of the Concrete properties table, make one repeat test immediately from another portion of the sample. If the value from the repeat test falls within the specified limits, the sample is acceptable.

Testing for compaction: To RELATIVE COMPACtion OF CONCRETE.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.
4.2 SITE ESTABLISHMENT

Subbase survey
Measure the base invert levels: If the underlying layer is required to be spray sealed, take levels on
the top of the seal and after removal of foreign or loose material such as aggregate.
Method: Report levels to the nearest mm and survey on 5.0 m grid on a plan area.
Requirement: Submit a work-as-executed survey of the subbase to the full extent of the works.
Highlight any locations where the actual level is higher then the design levels.
Submission type: HOLD POINT.
Non-conforming levels: In the case of non-conforming levels, locally redesign the pavement levels as
directed by the Superintendent.

4.3 TRIAL CONCRETE BASE

Construction
Trial section requirement: Before starting the paving works, construct a trial section of concrete base
including texturing, curing, sawing joints and placement of the tie bars and dowels.
Trial section: Construct as follows:
- Incorporate the trial section into the concrete base works.
- Construct separate trial sections for each concrete base type.
  - Length:
    . 50 to 100 m for mechanical placing.
    . 15 to 50 m for manual placement.
- Width: Same as proposed for the work.
Materials and methods: Construct the concrete base using the materials, concrete mix, equipment and
methods for the entire works.
Trial results: Provide test results to demonstrate conformance for compressive strength, compaction
and thickness.
Inspection: Notify the Superintendent for inspection of the completed trial concrete base.
Approval: Obtain approval of the trial section before starting the remaining works.
Inspection type: HOLD POINT.

Deficient trial section
Assessment: If there are deficiencies in the trial concrete base, review the method, equipment,
materials and personnel and submit a report.
Submission type: HOLD POINT.

Non-conforming trial section
General: If the trial concrete base is not approved, conform to the following:
- Submit changes proposed for construction of the new trial section including the equipment,
  materials, mix, plant or rate of paving.
- Remove the non-conforming base and make good any damage caused by such removal.
- Construct the new trial concrete base in conformance with REMOVAL AND REPLACEMENT OF
  CONCRETE BASE.
Inspection type: HOLD POINT.

4.4 SLAB ANCHORS

General
Location: Construct anchors normal to the control line, to the dimensions and at the locations shown
on the drawings and extended over the full width of the base.
Spacing: Place the associated transverse expansion joints at minimum distance of 2 m to from other
transverse joints.
Inspection type: WITNESS POINT.

Excavation
General: Remove all loose material, trim the vertical faces and compact the bottom of the trenches.
Inspection type: HOLD POINT.
Spoil: Dispose excavated material at approved locations.
Adjacent to flexible pavement: If a slab anchor is required at the junction of an existing flexible pavement, make a straight sawcut to the full depth of the asphaltic concrete or bituminous seal in the flexible pavement along the joint line.
Remediation: Make good any disturbance or damage to the flexible pavement.
Sub-soil drains: Provide a subsoil drain at the bottom of the trench to 1172 Subsoil and foundation drains.

Construction
Method: Produce, transport and place concrete for slab anchors to conform to the requirements for hand-placed base concrete.
Sequence: Pour slab anchors separately from the base slabs up to the top surface of the subbase.
Transverse isolation joint: Provide a transverse isolation joint on the downhill side of the slab anchor.
Steel reinforcement: As shown on the drawings.

Bridge approach slabs
Details: If not in the bridge contract, construct bridge approach slabs at bridge abutments to the dimensions and details shown on the drawings and to conform to the requirements for base concrete.

4.5 INSTALLATION OF STEEL REINFORCEMENT

General
Standard: AS 3600, clause 17.2.
Diameter, shape, dimensions and lapped splices: As shown on the drawings.
Lapped splices: The ends of the bars forming a lapped splice must be either welded or securely tied together in at least 2 places.
Storage: Store under a waterproof cover to prevent damage due to exposure and support clear of the ground.

Placing and cover requirements
Inspection: Submit for approval the placement and fastening of reinforcing steel before concrete placement. Allow adequate time in giving notice of inspection for all corrective works to be completed before placing concrete.
Inspection type: HOLD POINT.
Position: Conform to the following:
  - Secure the reinforcement in position by blocking from the forms, by supporting on bar chairs and by tying together.
  - Provide these supports in a regular grid not exceeding 1.0 m. Do not use wooden supports or pieces of aggregate.
Chair spacing: Make sure layout and spacing of chairs provide proper support with permanent deflection or displacement of the reinforcement no more than 2mm during placing and consolidation of the concrete.
Minimum bottom cover: 50 mm or as shown on the drawings.
Longitudinal steel: Conform to the following:
  - Placement: Place longitudinal steel on top of transverse steel.
  - Minimum top cover: 70 mm or as shown on the drawings.
Tack welding: To AS/NZS 1554.3 only in approved locations.

Tie bars: Conform to the following:
  - Place tie bars in their documented location. Do not place tie bars through the finished upper surface of the pavement.
  - Place tie bars either manually before placement of concrete or by an automatic tie bar inserter on the mechanical paver.
  - Provide details of the proposed method of tie bar insertion.
Dowelled joints: Conform to the following:
  - Place dowelled joints, parallel to the pavement surface and normal to the line of the joint, or as shown on the drawings.
- Install dowels ahead of paving by an approved dowel support assembly.
- Coat one end of each dowel on the same side of each joint for a distance of \((L/2 + 25 \text{ mm})\) with two coats of bitumen emulsion (or one coat of bitumen) and sanded to make sure free movement of the concrete base slab with temperature variations.
- Provide a preformed cap at the coated end to provide a minimum of 30 mm clearance for movement.
- Dowel ends: Check dowels before placement and make sure the dowels are straight and free of irregularities including burrs and protrusions.

4.6 PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE

**General**

Standard: To AS 1379.

**Concrete production and transport**

General: Submit the proposed work methods for the following:

- Handling, storing and batching of materials for concrete.
- Monitoring and measuring the constituent materials for concrete.
- Mixing and transport of concrete.

Submission type: HOLD POINT.

**Concrete delivery**

Delivery docket: For each batch of mix, keep record of the following delivery information:

- Supplier name and location.
- Volume of material supplied.
- Product constituents.
- Dispatch time and date.

Inspection type: WITNESS POINT.

Delivery time limits: After addition of the cement to the aggregate, concrete to be incorporated into the works within:

- 90 minutes if transported by truck mixer or agitator.
- 60 minutes if transported by non-agitating trucks.

4.7 PLACING AND FINISHING

**General**

Subbase surface condition: Clean and free of loose or foreign matter and prepared to 1132 Lean mix concrete subbase.

**Equipment and methods**

Proposal: Submit full details of the equipment and methods proposed for placing and finishing the concrete base together with a paving plan showing proposed paving widths, sequence and estimated daily outputs.

Submission type: HOLD POINT.

Notice: Give notice before construction of the concrete base on any section of work including the trial concrete base.

Inspection type: WITNESS POINT.

**Consistency**

Requirement: Supply concrete of a homogeneous, dense and non-segregated mass with low bleeding. If bleed water flows over the slab edge, cease paving until the mix is redesigned and approved.

Concrete edges: Construct edges with no sag or tear.

Testing: Perform slump tests on each truckload of concrete.

Timing of testing: Check the consistency of the concrete within 30 minutes of adding cement to the aggregate. If the actual haul time exceeds 45 minutes, also check the consistency immediately before discharge.

Slump tolerances:
- Mechanically placed concrete: ±10 mm.
- Hand placed concrete: ±15 mm.

Equipment: Provide all equipment, materials and labour for consistency testing.

Test results: Provide all consistency test results.

Inspection type: WITNESS POINT.

Ambient conditions

Air temperature: If the air temperature in the shade is below 10°C or above 30°C, protect the concrete from cold or hot weather. Provide detailed proposals for protection of concrete in cold or hot weather.

Concrete temperature limits: 5°C to 35°C.

Rain: In case of rain, protect the concrete from rain damage and provide detailed proposals for protection procedures.

Inspection type: WITNESS POINT.

Records: Measure and record concrete temperature and wind velocity at the point of concrete placement throughout the course of the work.

Equipment: Provide and maintain all equipment necessary for such measuring and recording.

Evaporation and moisture loss

Evaporation limit: Take precautionary measures when the value of rate of evaporation as determined from the Rate of evaporation graph, exceeds 0.50 kg/m²/hr. Obtain approval of the methods used to prevent moisture loss or cease work.

Inspection type: WITNESS POINT.

Evaporation retarder: If it is proposed to use an evaporation retarder to prevent excessive moisture loss, apply by fine spray after all finishing operations are complete, except minor manual bull-floating. Re-application of evaporation retarder after level floating may be directed as required.
Using the Rate of evaporation graph

Information: The graph shows the effects of air temperature, humidity, concrete temperature and wind velocity on the rate of evaporation of water from freshly placed and unprotected concrete.

Example: To determine the evaporation rate from the graph using air temperature at 27°C, relative humidity at 40%, concrete temperature at 27°C and a wind velocity of 26 km/h:
- Enter the graph at the air temperature of 27°C.
- Move vertically to intersect the curve for relative humidity encountered 40%.
- Move horizontally to the respective line for concrete temperature of 27°C.
- Move vertically down to the respective wind velocity curve and interpolate for 26 km/hour.
- Then move horizontally to the left to intersect the scale for the rate of evaporation.
- The rate of evaporation would be 1.6 kg/m²/hour.

Paving in general
Concrete finish: Dense and homogeneous with a surface exhibiting low porosity.
Continuity: Once spreading starts, maintain a continuous concrete paving operation.
Disruptions: If disruptions occur, form a construction joint before the restart of paving operations.
Inspection type: WITNESS POINT.
Non-monolithic concrete: If subsequent testing at the location of an interruption indicates the presence of non-monolithic concrete, remove and replace such concrete to REMOVAL AND REPLACEMENT OF BASE.

Mechanical paving
Paver machine: Conform to the following:
- A self-propelled machine with a gross operating mass of not less than 4 tonnes per lineal metre of paved width.
- Capable of paving at a speed of one metre per minute or less as required to enable the continuous operation of the paver and obtain the required degree of compaction.
- Include an automatic control system with a sensing device to control line and level to the specified tolerances.
- Able to spread the mix uniformly and regulate the flow of mix to the vibrators without segregation of the components.
- Contain internal vibrators capable of compacting the full depth of the concrete.
- Contain an adjustable extrusion screed and/or conforming plate to form the slab profile and produce the required finish on all surfaces.
- Capable of paving in the slab widths or combination of slab widths and slab depths shown on the drawings.

Concrete finish: Spread, compact, screed and finish the freshly placed concrete with the mechanical paver to minimise finishing by hand.

Spreading device: Use a separate device ahead of the mechanical paver as follows:
- To transport and spread concrete uniformly over the full pavement width.
- Without disturbing the reinforcement or its supports.
- Without segregating or otherwise adversely affecting the concrete.

Supporting surface: Provide smooth and firm supporting surface for the tracks of the paver, curing machine and any other equipment in the paving and curing train.

Hand placing
Restriction: Use hand placement only in areas where mechanical placement is not practical. Obtain approval before starting the works.

Formwork: Conform to the following:
- Designed and constructed for removal without damaging the concrete.
- True to line and grade.
- Braced to support wet concrete.
- Mortar tight.
- Prevents adhesion of concrete to the forms.

Placing in forms: Deliver concrete in agitator trucks and deposit uniformly in the forms without segregation.

Compaction: Compact the concrete by poker vibrators and by two passes only of a hand-guided vibratory screed traversing the full width of the slab on each pass.

Build-up: Prevent any build-up of concrete between the forms and vibratory screed.

Alignment and surface tolerances
Horizontal tolerances at outer edges: ± 30 mm.
Thickness: -0 mm/+10 mm.
Surface levels: Conform to the following:
- Deviation from the design levels: +10 mm/–0 mm
- Deviation from a 3 m straightedge, laid in any direction: 5 mm.

Ponding: Not acceptable.

Assessment of base thickness
Base survey: Perform survey runs to the nearest 5mm, taken on a 5m grid on the plan area and compare with the subbase survey to SITE ESTABLISHMENT, Subbase survey.

Alternative methods:
- Concrete cores.
- Measurement at the pavement edge.
- Audit checks: Obtain approval to use a suitable probe whilst the concrete is being placed measured to the nearest 5 mm.

**Inspection type: WITNESS POINT.**

**Non-conformance**

Non conforming thickness: If thickness is 10 mm or more below the specified thickness, remove and replace the base to REMOVAL AND REPLACEMENT OF BASE.

Thickness 10 mm or less below: If the thickness is 10 mm or less below the specified thickness and represents isolated sections within a lot, comprising less than 5% of the area of the lot, conform to DEDUCTIONS.

**Odd-shaped and mismatched slabs**

Definitions:
- Slab: A portion of concrete base bounded by joints or free edges.
- Slab dimensions: The average dimensions measured normal and parallel to the longitudinal joints.
- Odd shaped:
  - If the ratio of the longer dimension to the shorter dimension exceeds 1.6 or if the joint pattern produces an angle of less than 80 degrees between two adjacent sides.
  - Slabs containing blockouts for drainage structures will be considered as odd-shaped.
- Mismatched slabs: Where any joint meets a slab and is not continued across that slab.

Reinforcement for odd-shaped and mismatched slabs: Minimum SL 82 reinforcing fabric at top layer or as shown on the drawings. Place fabric clear of all transverse and longitudinal joints by 50 mm to 100 mm.

**Terminal slabs**

Placement location: Construct terminal slabs adjoining bridge approach slabs and at changes from a rigid pavement to a flexible pavement. Construct terminal slabs to the dimensions and details shown on the drawings.

**Surface texture**

Longitudinal texture: Texture surface with a hessian drag or approved equivalent. Adjust length of drag to achieve required texture.

Transverse texture: Conform to the following:
- As soon as possible after longitudinal texturing, transversely texture the surface of the freshly placed concrete.
- Use texturing equipment with rectangular-shaped tynes of flat spring steel, approximately 0.6 mm thick.
- Width of the tynes: 3 mm.
- Spacing of tynes: Randomly spaced between 10 mm and 21 mm, with an average spacing of 13-14 mm.

Brush or comb width: Minimum 750 mm. Provide for downward adjustment to compensate for wear.

Submission: Submit details of the proposed texturing device and demonstrate the method proposed to achieve the required texture.

**Submission type: HOLD POINT.**

Average texture depth: When tested to RMS Test Method T240, conform to the following:
- Longitudinal: 0.55 ± 0.05 mm.
- Transverse: 0.65 ± 0.05 mm.

Machine texture: For paving widths exceeding 4.5 m, perform texturing using a machine spanning the concrete slab and guided, with regard to both level and direction, by the rails, in the case of fixed-form construction, or by the paver guide wires.

Alternative: Where an asphalt surfacing is documented over the concrete base, or as directed, texture the surface with a fine broom or hessian-drag.

Remedial grooving: Transversely saw cut groove areas with less than the allowable average texture depth.
Saw-cut grooves: Conform to the following:
- Width: 3 mm.
- Depth: 3 mm.
- Spacing of grooves: Randomly spaced between 10 mm and 18 mm, with an average spacing of 12-15 mm.
- Procedure: Remove grooving residue from pavement and do not allow into drainage system or across lanes which are in public use.

Traffic considerations
Traffic restrictions: Do not allow traffic or construction equipment, other than that associated with testing, sawcutting, groove cleaning or joint sealing, on the finished base until the joints have been permanently sealed and at least 10 days have elapsed since placing concrete, and the concrete has reached a compressive strength of at least 20 MPa.
Traffic management: Traffic management required to effect the traffic restrictions to conform at a minimum with 1101 Control of traffic.
Additional measures: If such measures are warranted due to specific requirements provide additional traffic management measures either pedestrian or vehicular in excess of that specified.
Inspection type: WITNESS POINT.

4.8 JOINTS

Location
General: Provide joints at locations indicated on the drawings or as directed by the Superintendent.
Inspection type: WITNESS POINT.

Inspection of joints
Timing: Inspect each joint within 24 hours of its construction.

Sawcutting
Sequence: Saw joints by a two-cut operation as follows:
- Initial cut: 3 mm wide x 0.4(D) deep, where (D) is the full depth of the base slab.
- Widening cut: 7 mm wide x 35 mm below the surface of the base slab.
Timing: Between 6 hours and 24 hours after initial paving to avoid excessive raveling of aggregate adjacent to the cut.

Equipment: Use equipment and type of blade suited to the hardness of the concrete being sawn. Have standby equipment available on site to maintain continuity of sawing.
Tolerances: Maximum 10 mm deviation from a 3 m straight edge.

Raveling: Conform to the following:
- The surface of the transverse contraction joint is < 5 mm of vertical or horizontal edge raveling.
- The length of edge raveling is < 300 mm in any 1 m length of joint on each edge.
- Saw debris is washed from the joint and pavement immediately after sawing.
Non-conformance: Perform corrective actions if there are non-conforming sawcuts.

Cleaning of sawcut: Immediately after any sawing, clean the sawcut of all debris.
Method of cleaning: A pressurised liquid or liquid/air jet. Do not gravity feed cleaning liquid from tanks.

Neoprene compression sealants
Installation: Conform to the following:
- Coat the neoprene sealant with a clear or concrete-coloured lubricant compound approved by the Superintendent and conforming to ASTM D2835.
- Insert the sealant into the joint using equipment which does not damage the sealant during its insertion.
- The maximum increase in length of the sealant after installation: 5% of original length.
- Reject any sealant exceeding 5% extension.
- Locate the sealant in the transverse contraction joint in the design orientation without twist or buckle.
- Continuity between formed longitudinal joints: Where discontinuity occurs, angle butt joint the sealant by an approved method.
Silicone sealants
Preparation: Conform to the following:
- Clean out any foreign or disturbed material from the joint and from the top of the backer rod by dry air jet.
- Depress the backer rod to the depth such that the bottom of the silicone sealant is at the planned location and of the correct shape.
- If the backer rod is damaged in any way replace it for the full length of the joint.
Sealant installation: To the manufacturer's recommendations.
Treatment before asphalt overlay: If asphaltic surfacing over the concrete base is documented provide only the initial 3 mm wide saw cut and fill with silicone joint sealant.

Temporary sealing
Installation timing: Immediately after cleaning sawcut(s).
Temporary sealing material alternatives:
- Continuous closed-cell polyethylene backer rod of diameter shown on the drawings or as required by the Superintendent. Install the top of the sealant neither higher than nor more than 10 mm below the concrete surface and pass over any longitudinal joint seal already in place.
- Continuous UV-stabilised PVC spline 5 ± 1 mm in diameter installed at the top of the saw cut, passing under any sealant inserted in longitudinal sawn joints.
Maximum increase in length of a temporary sealant after installation: 10% of the original length.

Permanent sealing
Timing: Within ten days of initial sawing and immediately on removal of the temporary sealant, place the permanent sealant in the joint. The permanent sealant may be either a neoprene compression seal or an in situ cast silicone sealant.
Method of sealing: Submit the method for permanent sealing 4 weeks before sealing works.
Submission type: HOLD POINT.
Top of the sealant: Between 5 mm above and 7 mm below the surface of the base. Overlay any longitudinal sealants.

Transverse construction joints
Requirement: Conform to the following:
- Provide only at discontinuities in the placement of concrete determined by the paving operations.
- Do not place closer than 1.5 m to a transverse contraction joint. The Superintendent may authorise a change in the spacing and/or skew of transverse contraction joints to make sure that sufficient clearance is obtained.
- Construct normal to the control line and to the dimensions and details shown on the drawings.
- Tie bars: To conform to STEEL REINFORCEMENT.
- Make smooth across the joint before texturing.
- Do not to deviate from a 3 m straightedge placed along the joint by more than 10 mm.
- Align joints so that the skew angles of odd-shaped slabs is not increased.
Adjoining edge: Before placing adjoining concrete roughen the surface of the concrete to expose coarse aggregate. Wash clean the roughened surface and the projecting reinforcement and remove all excess water and loose material.

Transverse expansion joints
Extent: Continuous across the full width of the base.
Method and sealant: As shown on the drawings.

Transverse contraction joints
Extent: Continuous across the full width of the base.
Location: Normal to the control line and as shown on the drawings. Where necessary, the joint may be skewed to a maximum 1 in 12 to accommodate construction joints and slab anchors.
Method: Sawn or as shown on the drawings.
Plastic joint: If the concrete base is to be overlaid with an asphalt wearing course, the Superintendent may approve the joint to be formed with a suitable plastic joint inducing system.
Transverse isolation joints
Location: At bridge approach slabs and at slab anchors where shown on the drawings and where directed.

Construction: Continuous across the full width of the base normal to the control line and as shown the drawings.

Spacing: 2.0 m minimum to other transverse joints.

Changes: A change in the spacing and/or skew of adjacent transverse contraction joints to make sure that sufficient clearance is obtained may be approved or directed.

Joint filler: Preformed jointing material of bituminous fibreboard or equivalent joint sealant in conformance with the Silicone joint sealant requirements table.

Installation: In conformance with the drawings and the manufacturer’s recommendations except that reference to backer rods does not apply.

Tolerance: 10 mm maximum deviation from a 3 m straightedge placed along the joint.

Longitudinal isolation joints
Location: Provide longitudinal isolation joints where shown on the drawings and where directed by the Superintendent.

Tolerances:
- 10 mm maximum deviation from the designed position at any point.
- 10 mm maximum deviation from a 3 m straightedge.

Filler and sealant: Install preformed jointing material of bituminous fibreboard or as shown on the drawings. Install to conform to the drawings and the manufacturer’s recommendations except that reference to backer rods does not apply.

Longitudinal tied joints
Location: As shown on the drawings or as directed, parallel to the control line.

Method: Form or induce either by sawing or by machine insertion of a crack inducer ribbon.

Tie bars: Conform to the following:
- 12 mm diameter deformed steel bars Grade 500N, 1 m long and inserted to conform to INSTALLATION OF STEEL REINFORCEMENT, Placing and cover requirements.
- Locate and space as shown on the drawings.
- Omit tie bars within 500 mm of a transverse joint.
- Use hydrophilic epoxy resin when installing tie bars in existing concrete. Use the setting system to develop an anchorage strength at least 85% of the yield strength of the bar.

Tolerances:
- 10 mm maximum deviation from the designed position at any point.
- 10 mm maximum deviation from a 3 m straightedge with due allowance for any planned curvature.

Corrugated joint face: If the longitudinal tied joint is formed or slipformed, corrugate the joint face to conform to the details shown on the drawings.

Isolation joint: If the multi-lane width is greater than 18 m, construct a longitudinal isolation joint at each location shown on the drawings and to conform to Longitudinal isolation joints.

Asphalt surface: Provide longitudinal tied joints where asphalt surfacing is intended.

Sawn-induced joints
Location: Provide sawn longitudinal tied joints as shown on the drawings.

Sawcutting: Conform to Transverse contraction joints.

Joint cleaning: Remove all debris within 24 hours of sawing.

Sealant preparation: Insert a neoprene backing rod as shown on the drawings.

Sealant insertion: Conform to the following:
- Coat the sealant with lubricant-adhesive compound, coloured to approximately match the pavement.
- Insert the sealant into the groove using equipment which will not damage the sealant.
- Maximum increase in length of the sealant after installation: 10% of the original length.

Joints in sealant: Keep joints in the sealant to a minimum and cement together using an adhesive to the manufacturer’s recommendations.
Top of the sealant: Between 5 mm above and 7 mm below the surface of the base, except where the sealant is depressed to lie under the transverse joint sealant.

**Ribbon-induced joints**

Location: As shown on the drawings.

Insertion: By machine, so that the top of the ribbon does not protrude above the surface of the base, nor lie below the surface of the base by more than 3 mm.

Requirements: Provide the following:
- Inducer ribbon thickness: 0.5 mm minimum.
- Place it within 5° of the vertical plane.
- Reject inducer ribbon which curls on placement and when cut in the base is found to be curved in transverse section by more than 3 mm from straight.

Ribbon ends: Splice ribbon ends for continuity of the induced joint.

Asphalt surfacing over sawn longitudinal tied joints: Depress the sealant to a depth below the concrete surface not less than 10 mm and, following thorough cleaning, seal the joint flush with the concrete surface with bituminous rubber compound, compatible with the narrow groove.

**Kerb and/or gutter**

Application: Kerbs and/or gutters constructed within the shoulder of a concrete base.

Location: Construct the longitudinal joint parallel to the control line (parallel to the centre line for ramps) and to the dimensions shown on the drawings.

Construction: Form directly onto the concrete subbase. Cast either integrally with the concrete base or separately.

Face of joint: Do not scabble the face and do not seal the joint.

Tie bars: If constructed separately, tie kerbs and/or gutters to the concrete base by 12 mm diameter deformed steel tie bars Grade 250N or 500N, 1000 mm long at 1 m centres. Insert the tie bars in conformance with the drawings and INSTALLATION OF STEEL REINFORCEMENT, Placing and cover requirements.

Tolerances: Construct the line of the longitudinal joint to the tolerances to conform to Longitudinal tied joints.

Kerb and/or gutter: Construct to conform to 1121 Open drains, including kerb and gutter regardless of method of construction. Provide concrete with strength greater than 20MPa at 28 days.

**Longitudinal joint with kerb and/or gutter**

Tie bars: If the kerb and/or gutter is not constructed integrally with the concrete base, insert tie bars in conformance with the drawings and Placing and cover requirements.

Face of joint: Do not scabble the face and do not seal the joint.

**4.9 CURING**

**Application method**

Fine spray: Apply the curing compound using a fine spray and as follows:
- For transversely tynd surfaces: In two applications:
  - First application: Immediately following texturing.
  - Second application: Fifteen to thirty minutes later.
- At the rate stated on the certificate of conformance or at 0.2 litres/m², whichever rate is the greater.
- Apply bitumen emulsion at a minimum rate of 0.5 litres/m².
- Apply the curing compound with a mechanical sprayer, spraying transversely or longitudinally, with a spray boom fitted with nozzles spaced to give a uniform cover for the full paving width in a single pass.
- Use a sprayer which incorporates a device for continuous agitation and mixing of the compound in its container during spraying. Do not allow any dripping of the curing compound on the concrete surface, after shut-off of the spray nozzles.
- For hessian-dragged surface: Immediately following texturing at the rate stated on the Certificate of Conformance or 0.2 litres/m², which rate is the greater. Apply bitumen emulsion at a minimum rate of 0.5 litres/m².
Application time: Apply the curing compound immediately after the surface is free of bleed water, or as directed.

Application rate: Calculate the application rate. Check the amount of curing compound falling on three felt mats.

Inspection type: WITNESS POINT.

Hand spraying: For the sides of formed slabs and for small areas where a mechanical means of distribution cannot be used, spray the compound by hand lance at a rate 25% higher than that used on the main base.

Curing membrane: Conform to the following:
- Maintain the curing membrane intact for seven days after placing the concrete.
- Make good any damage to the curing membrane by handspraying the affected areas.

Equipment on site: Keep equipment and materials for curing operations on site at all times during concrete placement and curing.

Plant unavailable: If the mechanical sprayer becomes inoperable, cease concrete paving by mechanical means and do not restart until the mechanical sprayer becomes fully operable again.

4.10 CONCRETE CRACKING

Planned cracks
Definition: Full depth transverse cracks over the full width of a paving run.
Remedial work: Not required.

Unplanned cracks
Treatment: If unplanned cracking occurs, immediately implement treatment as follows:
- Fill cracks whose width exceeds 0.3 mm with a suitable low viscosity penetrating epoxy resin.
- Cross stitch individual longitudinal cracks which are greater than 300 mm long and which lie within 1.0 m of an edge or longitudinal joint, as detailed in the drawings.
- If the cumulative length of unplanned cracks exceeds 40 m in any 40 m² area measured between adjacent longitudinal joints or edges, remove that area of concrete base and replace base to conform to REMOVAL AND REPLACEMENT OF BASE.

Exception: Do not treat unplanned cracks not covered in items above.

4.11 TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH

Sampling
Method of sampling: AS 1012.1.
Sampling locations: Take samples from the delivery vehicles, or from concrete deposited ready for placement.

Minimum frequency of sampling: To AS 1379 and the following:
- At least one sample for the concrete being placed at one time.
- At least one sample for each lot.

Inspection type: HOLD POINT.

Making and curing of testing specimens
Standard: AS 1012.8.1.
Moulding: Mould at least two test specimens from each sample. Supply the number of moulds required for the documented frequency of testing.
Curing: Carry out initial curing on site between 18 to 36 hours.
Identification: Inspect, cap and mark specimens for identification before sending to testing laboratory.
Transport: Do not transport specimens within 3 hours of being cast.

Testing
Testing of specimens: Test each specimen for compressive strength to AS 1012.9.
Test authority: NATA registered laboratory.
Compressive strength of each sample: Average compressive strength of the two specimens taken from the sample and tested at the same age.

Age of specimens: 28 days, or 7 days (as required by the Conditions of Development Consent).
Adjustment due to age: If specimens are tested at more than 28 days after moulding, obtain the equivalent 28 day compressive strength by dividing the test compressive strength by the factor shown in the Concrete age conversion factors table. For intermediate ages determine the factor by interpolation.

Concrete age conversion factors table

<table>
<thead>
<tr>
<th>Age of specimen at time of test (days)</th>
<th>Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>1.00</td>
</tr>
<tr>
<td>35</td>
<td>1.02</td>
</tr>
<tr>
<td>42</td>
<td>1.04</td>
</tr>
<tr>
<td>49</td>
<td>1.06</td>
</tr>
<tr>
<td>56</td>
<td>1.08</td>
</tr>
<tr>
<td>70</td>
<td>1.10</td>
</tr>
<tr>
<td>84</td>
<td>1.12</td>
</tr>
<tr>
<td>112</td>
<td>1.14</td>
</tr>
<tr>
<td>140</td>
<td>1.16</td>
</tr>
<tr>
<td>168</td>
<td>1.18</td>
</tr>
<tr>
<td>196</td>
<td>1.20</td>
</tr>
<tr>
<td>224</td>
<td>1.22</td>
</tr>
<tr>
<td>308</td>
<td>1.24</td>
</tr>
<tr>
<td>365 or greater</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Acceptance criteria
Assessment process of test results: Project assessment to AS 1379.
Reports and records of test results: To AS 1012. Submit test results and keep copies on site.
Submission type: HOLD POINT.
Average compressive strength of samples representing the lot: To CONCRETE QUALITY REQUIREMENTS, Compressive strength.
Non-conforming concrete: Perform coring test to Testing by specimens cut from the work

Testing by specimens cut from the work
General: If the concrete base strength is non-conforming, request permission to core the in situ concrete base for testing of the actual compressive strength representing the particular lot.
Testing authority: NATA registered laboratory nominated by the Contractor.
Specimens' characteristics:
- Shape: Cylindrical cores.
- Preferred dimension of cores: 100 mm diameter.
- Minimum dimension of cores: 75 mm diameter or two and one half times the nominal size of the coarse aggregate, whichever is the greater.
- Tolerance in uncapped state: 5 mm.
- Minimum length: Same as the core diameter.
Frequency of coring: One core for each lot or one core for the area of concrete base placed between any two consecutive construction joints, whichever is the lesser. Nominate the lot represented by each core at the time of sampling and record before testing.
Coring procedure: Carry out core cutting in the presence of and at the locations nominated by the Superintendent.
Inspection type: WITNESS POINT.
Curing of cores: Despatch cores to arrive at the testing laboratory within 24 hours of the core being cut from the concrete base. Start wet curing within 24 hours of the receipt of the cores.
Test method: To AS 1012.14 and the following:
- Adjust the test strength determined for form by a factor to conform with Core strength factor table.
- Only use wet conditioning.
Core strength factor table

<table>
<thead>
<tr>
<th>Length/diameter ratio</th>
<th>Correction factor</th>
</tr>
</thead>
</table>
Great Lakes Council

1133 Plain and reinforced concrete base

<table>
<thead>
<tr>
<th>Length/diameter ratio</th>
<th>Correction factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.00</td>
<td>1.00</td>
</tr>
<tr>
<td>1.75</td>
<td>0.98</td>
</tr>
<tr>
<td>1.50</td>
<td>0.96</td>
</tr>
<tr>
<td>1.25</td>
<td>0.93</td>
</tr>
<tr>
<td>1.00</td>
<td>0.89</td>
</tr>
</tbody>
</table>

Interpolate factors for intermediate form ratios.

Acceptance criteria for cored concrete
Equivalent 28 days compressive strength of the specimens cut from work: To CONCRETE QUALITY REQUIREMENTS, Compressive strength.
Test results: Submit the test results for approval.
Submission type: HOLD POINT.
Non-conforming concrete: To REMOVAL AND REPLACEMENT OF CONCRETE BASE.

Remedial work after coring
Restoration method: Clean all core holes taken in the base and fill with non-shrink cementitious concrete having a compressive strength of not less than that in the base and a maximum nominal aggregate size of 10 mm.
Surface condition of the restored hole: Similar to the surrounding surface in texture and colour.
Inspection type: WITNESS POINT.
Guarantee: Guarantee the integrity of the core for a period of 6 months after the completion of works and passage by traffic. Make good any core sites damaged by traffic within the warranty period.

4.12 RELATIVE COMPACTION OF CONCRETE

Testing for relative compaction
Test specimens: Cut cores from the work to provide test specimens for determining the relative compaction of the concrete placed in the work.
Depth: Cut cores from the full depth of the concrete base to the requirements of AS 1012.14, with the following exceptions:
- The requirement that the concrete is at least 28 days old before the core is removed will not apply. However concrete must be not less than three days old in the warm season and six days old in the cool season, before removal.
- The minimum nominal diameter of the cores: 75 mm.
Location of cores: Select the location of coring to exclude joints, steel reinforcement or tie bars from the core. Select locations which will make sure that the whole of the concrete base conforms to the minimum requirements of the Worksection.
Marking: Mark cores for identification.
Storage: Place cores immediately either in a tank of lime saturated water or in an individual plastic bag, sealed to prevent water loss. Keep cores stored in plastic bags in the shade.
Temperature control: Do not subject cores to temperatures in excess of either ambient temperature or 23°C whichever is the higher, and to temperature < 10°C, until delivered to the testing laboratory.
Frequency of coring: Conform to the following:
- Minimum frequency: Take a minimum of one core specimen from each lot of concrete base represented by standard cylinders moulded to conform to Making and curing of testing specimens.
- Hand placed concrete: Take two cores to represent a section of work.
- A section of work is confined between construction joints.
- Hand-worked or placed base that is cast with machine-placed concrete and not separated from the machine-placed concrete is deemed to be part of the machine-placed concrete, and to be cored and tested as part of the machine-placed concrete base.
Curing: The core specimens to be wet conditioned to AS 1012.14 for not less than 24 hours immediately before testing for compaction.

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Testing: Determine the mass per unit volume of specimens at age 7 of days.
Relative compaction: The relative compaction of a core specimen is the ratio, expressed as a percentage, of the mass per unit volume of the core specimen to the average mass per unit volume of the standard cylinders used to determine the 7 day compressive strength from the same lot of concrete base. Mass per unit volume of both standard cylinders and cores to AS 1012.12.2.
Non-conformance: If the relative compaction is less than 98 %, remove and replace the lot represented by the core to conform to REMOVAL AND REPLACEMENT OF BASE.
Inspection type: WITNESS POINT.

4.13 REMOVAL AND REPLACEMENT OF BASE

General
Replacement method: Conform to the following:
- Rejected base, which extends more than 25 m longitudinally: Replace by mechanical means unless the slabs are odd-shaped or mismatched.
- Replace full slab widths between longitudinal joints and/or external edges.
- Approval: At least seven days before the base removal, submit details of the proposed removal methods.
Submission type: HOLD POINT.
Disposal: Dispose the removed base slabs at locations acceptable to the Superintendent.

Transverse sawcut
Location:
- At each end of the section of base to be removed, for the full depth of the base layer.
- Normal to the control line and not closer than 1.5 m to an existing contraction joint in the base.
Over sawing: Do not oversaw into the adjoining base or underlying subbase.

Longitudinal sawcuts
Location:
- Along existing longitudinal joints to define the edges of the base section for removal.
- Not extending more than 250 mm past the transverse sawcut at each end of the section to be removed.
Over sawing: Do not oversaw into the adjoining base or underlying subbase.

Replacement of base
Subbase preparation: Before construction of the replacement base, prepare and debond the subbase in conformance with 1132 LEAN MIX CONCRETE SUBBASE.
Replacement requirements: Conform to this worksection, including the following:
- Deeply scabble the joint faces on the adjoining slab at the transverse sawcuts, except the top 25 mm which is to be left smooth.
- Provide tie bars to form a transverse construction joint in conformance with JOINTS, Transverse construction joints.
- Provide transverse contraction joints continuous across the full width of the base containing the replaced section.
- Seal the length of the joint across the full width of the base with the same sealant as in adjacent work and in conformance with JOINTS, Transverse contraction joints.
- Deeply scabble the lower two-thirds of the depth of the longitudinal joint faces and remove loose concrete.
- Attach a crack inducer ribbon to the surface of any formed longitudinal joint in the replacement base and provide tie bars to form a longitudinal tied joint in conformance with JOINTS, Longitudinal tied joints.
- Set tie bars placed into hardened concrete in a hydrophilic epoxy resin. The setting system used to develop an anchorage strength at least 85 % of the yield strength of the bar.
Traffic restrictions: Do not allow traffic or construction equipment other than that associated with testing, sawcutting, groove cleaning or joint sealing on the section of base containing the replacement base until the joints have been permanently sealed and at least 10 days have elapsed since placing replacement base concrete or the concrete has reached a compressive strength of at least 20 MPa.
## 4.14 LIMITS AND TOLERANCES

### Application
Summary: The limits and tolerances applicable to this worksection are summarised in **Summary of limits and tolerances table**.

### Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection clause/ subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloride ion</td>
<td>Maximum 300 ppm</td>
<td>WATER, General</td>
</tr>
<tr>
<td>Sulfate ion</td>
<td>Maximum 400 ppm</td>
<td>WATER, General</td>
</tr>
<tr>
<td><strong>Aggregates</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine aggregate - Grading</td>
<td>To Fine aggregate grading table</td>
<td>AGGREGATES, Fine aggregates</td>
</tr>
<tr>
<td>Coarse Aggregate - Properties</td>
<td>To Coarse aggregate properties table</td>
<td>AGGREGATES, Coarse aggregates</td>
</tr>
<tr>
<td><strong>Concrete quality</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement content</td>
<td>Minimum 270 kg/m³</td>
<td>CONCRETE QUALITY REQUIREMENTS, Cement and flyash</td>
</tr>
<tr>
<td>Flyash</td>
<td>Minimum 50 kg/m³</td>
<td></td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>The minimum 28 day compressive strength: 35 MPa.</td>
<td></td>
</tr>
<tr>
<td>Shrinkage</td>
<td>Not to exceed 450 με after 3 weeks of air drying.</td>
<td>CONCRETE QUALITY REQUIREMENTS, Drying Shrinkage</td>
</tr>
<tr>
<td><strong>Slump</strong></td>
<td>30 mm - 40 mm for mechanically placed concrete</td>
<td>CONCRETE QUALITY REQUIREMENTS, Consistency</td>
</tr>
<tr>
<td>55 mm - 65 mm for hand placed concrete</td>
<td>Vebe time reading – maximum of 3 seconds</td>
<td></td>
</tr>
<tr>
<td><strong>Air content</strong></td>
<td>4% to 7% when discharged from the transport vehicle</td>
<td>CONCRETE QUALITY REQUIREMENTS, Air content</td>
</tr>
<tr>
<td>ready for placement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concrete mixing and transport</strong></td>
<td>After addition of cement to the aggregate, concrete to be incorporated into the work within: 90 minutes where transported by truck mixer or agitator. 80 minutes where transported by non-agitating trucks.</td>
<td>PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE, Concrete delivery</td>
</tr>
<tr>
<td><strong>Concrete placing</strong></td>
<td>Protect the concrete when it rains or when the air temperature in the shade is below 10°C or above 30°C. The temperature of the concrete to be within 5°C to 35°C.</td>
<td>PLACING AND FINISHING, Ambient conditions</td>
</tr>
<tr>
<td></td>
<td>Take precautionary measures if the value of Rate of Evaporation exceeds 0.50 kg/m²/hr, cease work.</td>
<td>PLACING AND FINISHING, Evaporation and moisture loss</td>
</tr>
<tr>
<td><strong>Alignment and surface</strong></td>
<td>Horizontal alignment of outer edges ± 30 mm.</td>
<td>PLACING AND FINISHING,</td>
</tr>
<tr>
<td>Activity</td>
<td>Limits/Tolerances</td>
<td>Worksection clause/ subclause</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Surface level tolerance</td>
<td>+10 mm / −0 mm from design surface levels.</td>
<td>Alignment and surface tolerances</td>
</tr>
<tr>
<td></td>
<td>±5 mm over a 3 m straightedge.</td>
<td></td>
</tr>
<tr>
<td>Average surface texture depth</td>
<td>0.3 mm - 0.65mm.</td>
<td>PLACING AND FINISHING, Surface texture</td>
</tr>
<tr>
<td>Joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>±10 mm over a 3 m straightedge.</td>
<td>JOINTS</td>
</tr>
<tr>
<td>Transverse contraction joints</td>
<td>May skew 1 in 12 to accommodate construction joints and slab anchors.</td>
<td>JOINTS, Transverse contraction joints</td>
</tr>
<tr>
<td></td>
<td>±10 mm over a 3 m straightedge.</td>
<td></td>
</tr>
<tr>
<td>Sawcutting</td>
<td>The surface of the joint not to have more than 5 mm of vertical or horizontal edge</td>
<td>JOINTS, Sawcutting</td>
</tr>
<tr>
<td></td>
<td>edge ravelling.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The length of edge ravelling to be not more than 300 mm in any 1 m length of joint</td>
<td></td>
</tr>
<tr>
<td></td>
<td>on each edge.</td>
<td></td>
</tr>
<tr>
<td>Temporary sealing</td>
<td>Temporary Sealing—the top of the sealant to be neither higher than nor more than 10</td>
<td>JOINTS, Temporary sealing</td>
</tr>
<tr>
<td></td>
<td>mm below the concrete surface.</td>
<td></td>
</tr>
<tr>
<td>Permanent sealing</td>
<td>Permanent Sealing—The top of the sealant to be neither less than 5 mm nor more than</td>
<td>JOINTS, Permanent sealing</td>
</tr>
<tr>
<td></td>
<td>7 mm below the surface of the base.</td>
<td></td>
</tr>
<tr>
<td>Longitudinal tied joints</td>
<td>All parts of any tie bar to be within 50 mm of its designed position.</td>
<td>JOINTS, Longitudinal tied joints</td>
</tr>
<tr>
<td></td>
<td>The line of longitudinal tied joints not to deviate from the designed position at</td>
<td></td>
</tr>
<tr>
<td></td>
<td>any point by more than 10 mm and not deviate from a 3 m straightedge by more than</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 mm having made due allowance for any planned curvature.</td>
<td></td>
</tr>
<tr>
<td>Sawn-Induced joints</td>
<td>The maximum increase in length of the sealant after installation to be 10% of the</td>
<td>JOINTS, Sawn-Induced Joints</td>
</tr>
<tr>
<td></td>
<td>original length.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The top of the sealant to be neither less than 5 mm nor more than 7 mm below the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>surface of the base.</td>
<td></td>
</tr>
<tr>
<td>Ribbon-Induced joints</td>
<td>The inducer ribbon to be a minimum of 0.5 mm thick and within 5° of the vertical</td>
<td>JOINTS, Ribbon-Induced Joints</td>
</tr>
<tr>
<td></td>
<td>plane.</td>
<td></td>
</tr>
<tr>
<td>Slab anchors</td>
<td>Not placed closer than 2.0 m to transverse joints (other than associated transverse</td>
<td>SLAB ANCHORS, General</td>
</tr>
<tr>
<td></td>
<td>expansion joints).</td>
<td></td>
</tr>
</tbody>
</table>

### 5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

#### 5.1 MEASUREMENT

**General**

Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1133.1 to 1133.10 inclusive.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

**Methodology**

General: The following methodology will be applied for measurement and payment:

- If the 28 day compressive strength of test cylinders for any lot is less than 33 MPa, remove the lot represented by the test cylinders. No payment will be made.
- If the relative compaction of the concrete is determined at less than 98 %, remove the lot represented by the core. No payment will be made.
- If the concrete base thickness is more than 10 mm below the documented thickness, remove the concrete. No payment will be made.
- Preparation of subbase and application of bond breaker: Conform to 1132 Lean mix concrete subbase.
- Construction of kerb and/or gutter: Conform to 1121 Open drains, including kerb and gutter.
- Subsoil drains at slab anchors: Conform to this worksection and not 1172 Subsoil and foundation drains.
- Site specific traffic management measures: Conform to 1101 Control of traffic.

5.2 DEDUCTIONS

General
Deductions: Conform to the following:
- Concrete with a 28 day compressive strength between 33 MPa and 35 Mpa: Subject to a deduction of 4% of the applicable schedule rate for Pay Item 1133.1 for the lot represented, for each 0.5 Mpa, or part that, deficiency in strength.
- Acceptance of this concrete is conditional on it representing isolated sections and such sections comprise less than 5 % of the area of the base.
- Concrete base which is 10 mm or less below the specified thickness, after application of allowable tolerances for the base, may be accepted. Subject to a deduction to the schedule rate for Pay Item 1133.1, for the lot represented:
  . 24% for areas with thickness 5 mm below the documented thickness.
  . 60% for areas with thickness between 5 mm and 10 mm below the documented thickness.

5.3 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1133.1 Supply and place concrete in base</td>
<td>m²</td>
<td>The width and length as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. The depth is the depth documented or as directed by the Superintendent across each section. Take no account of the allowable tolerances. All costs associated with all documentation and approvals and the supply and placing of concrete base including all costs of providing transverse construction joints and longitudinal tied joints in association with kerbs and/or gutters.</td>
</tr>
<tr>
<td>1133.2 Finish, cure and texture base</td>
<td>m²</td>
<td>The width and length as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. Take no account of the allowable tolerances. The sides of slabs are not included in the measurement of surface area. All costs associated with finishing, curing and texturing the base.</td>
</tr>
<tr>
<td>1133.3 Supply and place wire reinforcing fabric</td>
<td>m² of wire reinforcing fabric placed</td>
<td>The width and length are as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent. All costs associated with supplying and placing all wire reinforcing fabric.</td>
</tr>
<tr>
<td>Pay Items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1133.4 Supply and install steel bar reinforcement</td>
<td>-Take no account of the allowable tolerances or of any laps.</td>
<td>All costs associated with supplying and installing reinforcement, except dowels and tie bars.</td>
</tr>
<tr>
<td>1133.5 Transverse contraction joints</td>
<td>Linear metre Measure the distance along the line of the joint.</td>
<td>All costs associated with the provision of transverse contraction joints.</td>
</tr>
<tr>
<td>1133.6 Transverse expansion and isolation joints</td>
<td>Linear metre Measure the distance along the line of the joint.</td>
<td>All costs associated with the provision of transverse expansion and isolation joints.</td>
</tr>
<tr>
<td>1133.7 Longitudinal tied joints</td>
<td>Linear metre Measure the distance along the line of the joint.</td>
<td>All costs associated with the provision of longitudinal tied joints including provision of tie bars.</td>
</tr>
<tr>
<td>1133.8 Longitudinal isolation joints</td>
<td>Linear metre Measure the distance along the line of the joint.</td>
<td>All costs associated with provision of longitudinal isolation joints including the provision of dowels where specified or shown on the drawings</td>
</tr>
<tr>
<td>1133.9 Slab anchors</td>
<td>m² The volume as shown on the drawings with adjustments for any authorised variation. The depth is to be measured from the top of the subbase.</td>
<td>All costs associated with the construction of slab anchors including excavation, disposal of material, supply and placing of reinforcement and the subsoil drain</td>
</tr>
<tr>
<td>1133.10 Bridge approach slabs</td>
<td>m² -The width, depth and length are as specified on the drawings, or as directed by the Superintendent. -Take no account of the allowable tolerances.</td>
<td>All costs associated with the construction of a bridge approach slab, including provision of a transverse expansion joint at the bridge abutment, but excluding the supply and fixing of steel which is to be paid for at the schedule rate for Pay item 1133.4.</td>
</tr>
</tbody>
</table>
1 GENERAL

1.1 RESPONSIBILITIES

General
Requirement: Provide flexible pavement base and subbase, including supply, spreading, compaction and trimming as documented.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.
- 1113 Stabilisation.
- 1143 Sprayed bituminous surfacing.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used

Australian standards
AS 1141 Methods for sampling and testing aggregates
AS 1141.3.1 Sampling - aggregates
AS 1141.14 Particle shape, by proportional calliper
AS 1141.22 Wet/dry strength variation
AS 1141.23 Los Angeles value
AS 1141.52 Unconfined cohesion of compacted pavement materials
AS 1289 Methods of testing soils for engineering purposes
AS 1289.3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point Casagrande method
AS 1289.3.3.1 Soil classification tests - Calculation of the plasticity index of a soil
AS 1289.3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method
AS 1289.3.6.1 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving
AS 1289.5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort
AS 1289.5.2.1 Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort
AS 1289.5.3.2 Soil compaction and density tests - Determination of the field dry density of a soil - Sand replacement method using a sand pouring can, with or without a volume displacer
AS 1289.5.4.1 Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1 Soil compaction and density tests - Compaction control test - Hilt density ratio and Hilt moisture variation (rapid method)
AS 1289.5.8.1 Soil compaction and density tests - Determination of field density and field moisture content of a soil using a nuclear surface moisture-density gauge - Direct transmission mode
AS 1289.6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen

AS 5101.4 Methods for preparation and testing of stabilized materials – Unconfined compressive strength of compacted materials

Other publications

ARRB

Austroads
AGPT04A Guide to pavement technology Part 4A: Granular base and subbase materials

AGPT04D Guide to pavement technology Part 4D: Stabilised materials

RMS Test Methods
T130 Dry density/moisture relationship of road construction materials (blended in the laboratory with cementitious binders).

T171 Modified Texas triaxial compression test pavement materials

RMS 3051 RMS Specification Granular base and subbase materials for surfaced road pavements.

1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- CBR: California bearing ratio.
- CRB: Crushed rock base.
- CRS: Crushed rock subbase.
- NGB: Natural gravel base.
- NGS: Natural gravel subbase.
- RCCB: Recycled crushed concrete base.
- RCCS: Recycled crushed concrete subbase.
- UCS: Unconfined compressive strength.

Definitions
General: For the purposes of this worksection the following definitions apply:
- Base: Layer(s) of material forming the uppermost structural element of a pavement and on which the surfacing may be placed which may be composed of fine crushed rock, natural gravel, broken stone, stabilised material, asphalt or Portland cement concrete.
- Bound material: A granular or subgrade material to which a binder has been added to improve structural stiffness.
- Flexible pavement: A pavement which obtains its load-spreading properties from intergranular pressure, mechanical interlock and cohesion between the particles of the pavement material.
- Modified material: Granular materials to which small amounts of stabilising agent have been added to improve their performance without causing a significant increase in structural stiffness.
- Pozzolan: A siliceous or alumino siliceous material, which in itself possesses little or no cementitious value but which in finely divided form may be mixed with lime or Portland cement to form a cementitious material.
- Subbase: The material laid on the subgrade below the base either for the purpose of making up additional pavement thickness required over the subgrade, or to prevent intrusion of the subgrade into the base, or to provide a working platform.
- Unbound material: A granular material with no significant capacity to resist tensile stresses.
- RMS – Roads and Maritime Services

1.5 HOLD POINTS AND WITNESS POINTS

Approval
Submissions: To the Superintendent’s approval.
Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINT table

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRE-CONSTRUCTION PLANNING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pavement plan</td>
<td>Prepare and submit pavement plan</td>
<td>4 weeks before commencing site work</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Design and control of base and subbase materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed materials</td>
<td>Prepare and submit schedule detailing material properties including NATA test results</td>
<td>2 weeks before ordering materials</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Bound or modified materials</td>
<td>Dealt with in CC.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variations to approved materials</td>
<td>Submit details of changes to approved materials</td>
<td>1 week before use in works</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td><strong>Inspection, sampling and testing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notification</td>
<td>Written notice for testing times and provide test results</td>
<td>3 working days prior to testing or inspection</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified Texas triaxial classification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternative materials</td>
<td>Submit details of alternative material including test results</td>
<td>2 weeks before ordering materials</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td>Lime modified base and subbase materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lime modification</td>
<td>Submit proposals to modify materials</td>
<td>2 weeks before placing</td>
<td>Superintendent</td>
</tr>
<tr>
<td>In-situ lime modification</td>
<td>Submit proposals for the in-situ use of hydrated lime or quicklime</td>
<td>2 weeks before activity</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spreading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underlying layer</td>
<td>Inspection to determine suitability of underlying layer</td>
<td>1 working day before placing next layer</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td>Temperature</td>
<td>Submit proposal to proceed outside allowable conditions</td>
<td>1 working day before placement</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Trimming, compaction and curing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant</td>
<td>Submit details of proposed hand operated plant</td>
<td>1 week before use</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Subsequent layers</td>
<td>Submit completed test results of previous layer</td>
<td>1 working day before placing next layer</td>
<td>Superintendent &amp; Councils Engineering</td>
</tr>
<tr>
<td>Clause title/item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td>Release by</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>-------------------------------------------------------</td>
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<td>-------------------------------------------------</td>
</tr>
<tr>
<td><strong>Acceptance of compaction</strong></td>
<td><strong>Lots for acceptance</strong></td>
<td>1 working day after testing</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td></td>
<td>Submit compaction test results</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Compaction requirements and acceptance</strong></td>
<td><strong>Submit evidence that compaction is within tolerances</strong></td>
<td>1 working day after test results</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td><strong>Acceptance of dimensions and levels</strong></td>
<td><strong>General</strong></td>
<td>1 working day before next activity</td>
<td>Superintendent</td>
</tr>
<tr>
<td></td>
<td>Submit lot survey reports</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Corrective action - Rejected unbound layers</strong></td>
<td><strong>Submit proposal for corrective action</strong></td>
<td>3 working day before next activity</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td><strong>Corrective action - Rejected bound layers</strong></td>
<td><strong>Submit proposal for corrective action</strong></td>
<td>3 working days before next activity</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td><strong>Removal and replacement of rejected courses</strong></td>
<td><strong>Extent of removal</strong></td>
<td>1 working day before next activity</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td></td>
<td>Submit proposal to remove less than full width</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Prior to replacement</strong></td>
<td>1 working day before next activity</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td></td>
<td>Give notice for inspection of underlying material</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Replacement</strong></td>
<td>1 working day before next activity</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td></td>
<td>Submit proposed methods to make good</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Maintenance before completion of wearing surface</strong></td>
<td><strong>Pavement condition before primerseal</strong></td>
<td>3 working days before next activity</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td></td>
<td>Dry-back, re-prepare and give notice for inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Opening bound pavement to traffic</strong></td>
<td>3 working days before proposed opening</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td></td>
<td>Give notice of proposed opening to traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WITNESS POINT table</strong></td>
<td><strong>Clause title/item</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td><strong>Bound base and subbase materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-situ stabilisation</td>
<td>Give notice of proposal to use mobile plant for in-situ stabilisation at site</td>
<td>2 weeks before activity &amp; Councils Engineering Development Officer</td>
<td></td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td><strong>Clause title/item</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clause title/Item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Delivery</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivered materials</td>
<td>Give notice for inspection</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Delivery of modified or bound materials</td>
<td>Only vehicles with covers to be used. Give notice of use of vehicles without covers</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Delivery dockets bound material</td>
<td>Provide delivery dockets at point of delivery (Optional for Developer works. Required for Council Projects)</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td><strong>Stockpiling unbound material</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Give notice of proposed alternative locations</td>
<td>2 weeks before stockpiling</td>
<td></td>
</tr>
<tr>
<td><strong>Trimming, compaction and curing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction</td>
<td>Give notice of proposal to use alternative layer thickness</td>
<td>2 weeks before activity &amp; Councils Engineering Development Officer</td>
<td></td>
</tr>
<tr>
<td>Rework</td>
<td>Give notice for inspection of reworked wetted up layer</td>
<td>Progressive &amp; Councils Engineering Development Officer</td>
<td></td>
</tr>
<tr>
<td>Curing of bound materials</td>
<td>Give notice of water curing activities</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td><strong>Acceptance of compaction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear density Meter testing</td>
<td>Give notice of proposal to use nuclear density meter</td>
<td>1 working day before use</td>
<td></td>
</tr>
<tr>
<td><strong>Acceptance of dimensions and levels</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer width</td>
<td>Give notice of completion of layer width to Councils Engineering Development Officer for development or to Council Superintendent for Council projects.</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Subbase surface deviation</td>
<td>Give notice of completed subbase surface to Councils Engineering Development Officer for development or to Council Superintendent for Council projects.</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Base surface deviation</td>
<td>Give notice of completed base surface to Councils Engineering Development Officer for development or to Council Superintendent for Council projects.</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Base adjacent to kerb and gutter</td>
<td>Give notice of completed base surface to Councils Engineering Development Officer for development or to Council Superintendent for Council projects.</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Maintenance before completion of wearing surface</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primerseal</td>
<td>Give notice of alternative procedure</td>
<td>At time of lot acceptance</td>
<td></td>
</tr>
<tr>
<td>Restrictions on movement</td>
<td>Give notice if vehicles are to use unbound pavement before</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Clause title/Item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>-----------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>application of primerseal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 ACTIVITY PLAN

General
Program: Plan the following activities:
- Allocation of plant and personnel for the contract period.
- Work programming to meet the constraints of HOLD POINTS and WITNESS POINTS.

Pavement construction plan
Requirements: Prepare and submit a Pavement construction plan for the flexible base and subbase construction consistent with the drawings and subject to direction by the Superintendent. Include the following:
- A time based program to conform to Contract constraints.
- A drawn sectional plan showing lots and sequence.
- Site availability, assumptions on weather, plant and materials.
- A list of activities requiring approvals or notification of local authorities, statutory bodies, and local residents.
- Off-site storage of plant, personnel and maintenance facilities.
- On-site accommodation of personnel and communication facilities.
  Submission: HOLD POINT.

2.2 DESIGN AND CONTROL OF BASE AND SUBBASE MATERIALS

Proposed materials
Schedule: Submit a schedule detailing the material properties of the proposed base and subbase, including sources of supply and the proposed type and proportion of any binder. Include test results from a NATA registered laboratory as evidence that material properties conform to the requirements of this worksection.
Submission: HOLD POINT.

Bound or modified materials
Stabilisation: If the proposed base or subbase is a bound or modified material, submit a completed Annexure A of 1113 Stabilisation.
Submission: HOLD POINT.

Approved base and subbase
General: Once the proposed materials have been approved, they are known as the approved base and subbase.
Pre-approval: Proposed base or subbase may be pre-approved under the following conditions:
- If full approved details have been previously used.
- If the material properties remain unchanged from that previously approved.
- If the in-service performance of the base or subbase incorporating the nominated materials is acceptable.

Variations to approved materials
Written approval: Submit details of any changes to the approved base and subbase or source of supply.
Submission: HOLD POINT.

Non-conformance: Any change to the approved base and subbase, without approval will be considered a non-conforming material and may be rejected.
2.3 INSPECTION, SAMPLING AND TESTING

General
Extant: Inspect, sample and test the base and subbase material before, on delivery, during and after construction, for conformance with this worksection.

Accreditation: Testing by a NATA registered laboratory with appropriate accreditation and suitably qualified personnel.

Notification
Notice: Give notice of when testing is to be carried out and submit copies of all test results.
Submission: HOLD POINT.

3 MATERIALS

3.1 UNBOUND BASE AND SUBBASE MATERIALS

Unbound Base and Sub Base materials for use in the Great Lakes LGA shall be based on the RMS Specification 3051 as related to this specification application. Due notice is to be paid to the Traffic Category for the class of road and the actual or expected traffic volume and class. The context of this specification shall be applied with the specifics re-grading curve, water content etc taken from the RMS specification 3051.

Recycled crushed concrete
Designation: Recycled crushed concrete materials are designated as follows:
- RCCB20-1: 20 mm nominal sized class 1 recycled crushed concrete base.
- RCCB20-2: 20 mm nominal sized class 2 recycled crushed concrete base.
- RCCS20: 20 mm nominal sized recycled crushed concrete subbase.

Natural gravel (Refer to Note under Clause 3.1)
Designation: Unbound natural gravel materials are designated as follows:
- NGB20: 20 mm nominal sized natural gravel base.
- NGS20: 20 mm nominal sized natural gravel subbase.
- NGS40: 40 mm nominal sized natural gravel subbase.

Base material properties (Refer to Noted under Clause 3.1)
Base materials: Conform to the Base material properties table.

Base material properties table (Refer to Note under Clause 3.1)

<table>
<thead>
<tr>
<th>Test method</th>
<th>Description</th>
<th>CRB20-1</th>
<th>CRB20-2</th>
<th>RCCB20-1</th>
<th>RCCB20-2</th>
<th>NGB20</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1289.3.6.1</td>
<td>Particle size distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% passing 26.5 mm sieve</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>% passing 19.0 mm sieve</td>
<td>95–100</td>
<td>95–100</td>
<td>95–100</td>
<td>95–100</td>
<td>93–100</td>
</tr>
<tr>
<td></td>
<td>% passing 13.2 mm sieve</td>
<td>77–93</td>
<td>77–93</td>
<td>78–92</td>
<td>78–92</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>% passing 9.5 mm sieve</td>
<td>63–83</td>
<td>63–83</td>
<td>63–83</td>
<td>63–83</td>
<td>71–87</td>
</tr>
<tr>
<td></td>
<td>% passing 4.75 mm sieve</td>
<td>44–64</td>
<td>44–64</td>
<td>44–64</td>
<td>44–64</td>
<td>47–70</td>
</tr>
<tr>
<td></td>
<td>% passing 2.36 mm sieve</td>
<td>29–49</td>
<td>29–49</td>
<td>30–48</td>
<td>30–48</td>
<td>35–56</td>
</tr>
<tr>
<td></td>
<td>% passing 0.425 mm sieve</td>
<td>13–23</td>
<td>13–23</td>
<td>13–21</td>
<td>13–21</td>
<td>14–32</td>
</tr>
<tr>
<td></td>
<td>% passing 0.075 mm sieve</td>
<td>5–11</td>
<td>5–11</td>
<td>5–9</td>
<td>5–9</td>
<td>6–20</td>
</tr>
<tr>
<td>AS 1289.3.1.1</td>
<td>Liquid limit</td>
<td>max 30</td>
<td>max 30</td>
<td>max 35</td>
<td>max 35</td>
<td>max 25</td>
</tr>
<tr>
<td>AS 1289.3.3.1</td>
<td>Plasticity index: All areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Areas with annual rainfall &gt; 500 mm</td>
<td>min 2</td>
<td>min 2</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Areas with annual rainfall &lt; 500 mm</td>
<td>max 6</td>
<td>max 6</td>
<td>max 6</td>
<td>max 6</td>
<td>max 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>max 10</td>
<td>max 10</td>
<td>max 10</td>
<td>max 10</td>
<td>max 10</td>
</tr>
</tbody>
</table>
## Test method Description | CRB20-1 | CRB20-2 | RCCB20-1 | RCCB20-2 | NGB20
---|---|---|---|---|---
AS 1289.3.4.1 Linear shrinkage: All areas Areas with annual rainfall > 500 mm Areas with annual rainfall < 500 mm | min 0.7 | — | min 0.7 | — | —
| max 2.0 | max 2.0 | max 2.0 | max 2.0 | max 2.0 | max 2.0
| max 4.0 | max 4.0 | max 4.0 | max 4.0 | max 4.0 | max 4.0
Direct measurement Foreign materials in that fraction of RCCB retained on 4.75 mm sieve - % by mass: High density (brick, etc) Low density (plaster, etc) Organic matter (wood, etc) Asbestos and hazardous | — | — | max 2.0 | max 2.0 | —
| — | — | max 0.5 | max 0.5 | —
| — | — | max 0.1 | max 0.1 | —
| — | — | 0 | 0 | —
AS 1141.52 Maximum dry compressive strength on fraction passing 19 mm sieve (only applies if plasticity index is less than 1) | min 1.7 MPa | min 1.7 MPa | min 1.7 MPa | min 1.7 MPa | min 1.7 MPa
AS 1141.14 Particle shape by proportional calliper - % misshapen (2:1) | max 35% | max 35% | max 35% | max 35% | —
AS 1141.22 Aggregate wet strength* | min 100 kN | min 80 kN | min 100 kN | min 80 kN | —
AS 1141.22 Wet/dry strength variation* | max 35% | max 35% | max 35% | max 35% | —
AS 1141.23 Los Angeles value | max 35% | max 35% | max 40% | max 40% | —
AS 1289.6.1.1 4 day soaked CBR (98% modified compaction) | min 80% | min 80% | min 80% | min 80% | min 80%
AS 5101.4 Unconfined compressive strength (UCS) | max 1.0 MPa | max 1.0 MPa | max 1.0 MPa | max 1.0 MPa | —

**NOTES:**
* All fractions of the proposed mix must satisfy this requirement. Use the fraction with the highest wet/dry strength variation as the value for determining conformance. Test the fraction 19.0 mm to 9.5 mm. In the case of blended materials, also test the fraction 9.5 mm to 4.75 mm. Test any other fraction which is at risk of failing, in the opinion of the Superintendent.

---

### Subbase material properties (Refer to Note under Clause 3.1)

Subbase materials: Conform to the Subbase material properties table.

### Subbase material properties table (Refer to Note under Clause 3.1)

| Test method | Description | CRS20 | CRS40 | RCCS20 | NGS20 | NGS40 |
---|---|---|---|---|---|---|
AS 1289.3.6.1 Particle size distribution % passing 53.0 mm sieve % passing 37.5 mm sieve % passing 26.5 mm sieve % passing 19.0 mm sieve % passing 13.2 mm sieve % passing 9.5 mm sieve | — | 100 | — | — | 100 | — | 95-100 | 80-97 | — | — |
| | 100 | 74-96 | 100 | 100 | 100 | 100 | 80-97 | — | — | — |
| | 90-100 | 62-86 | 95-100 | 96-100 | 96-100 | 96-100 | 80-97 | — | — | — |
| | 74-96 | — | 75-95 | — | — | — | — | — | — | — |

© AUS-SPEC (Oct 14) 8 April 2015
<table>
<thead>
<tr>
<th>Test method</th>
<th>Description</th>
<th>CRS20</th>
<th>CRS40</th>
<th>RCCS20</th>
<th>NGS20</th>
<th>NGS40</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1289.3.1.1</td>
<td>Liquid limit</td>
<td>max 35</td>
<td>max 35</td>
<td>max 40</td>
<td>max 35</td>
<td>max 35</td>
</tr>
<tr>
<td>AS 1289.3.3.1</td>
<td>Plasticity index:Areas with annual rainfall &gt; 500 mm</td>
<td>max 12</td>
<td>max 12</td>
<td>max 12</td>
<td>max 12</td>
<td>max 12</td>
</tr>
<tr>
<td></td>
<td>Areas with annual rainfall &lt; 500 mm</td>
<td>max 15</td>
<td>max 15</td>
<td>max 15</td>
<td>max 15</td>
<td>max 15</td>
</tr>
<tr>
<td>AS 1289.3.4.1</td>
<td>Linear shrinkage:Areas with annual rainfall &gt; 500 mm</td>
<td>max 4.5</td>
<td>max 4.5</td>
<td>max 4.5</td>
<td>max 4.5</td>
<td>max 4.5</td>
</tr>
<tr>
<td></td>
<td>Areas with annual rainfall &lt; 500 mm</td>
<td>max 6.0</td>
<td>max 6.0</td>
<td>max 6.0</td>
<td>max 6.0</td>
<td>max 6.0</td>
</tr>
<tr>
<td>Direct</td>
<td>Foreign materials in that fraction of RCCS retained on 4.75 mm sieve - % by mass:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>measurement</td>
<td>High density (brick, glass, etc)</td>
<td></td>
<td></td>
<td>max 3.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low density (plaster, clay, etc)</td>
<td></td>
<td></td>
<td>max 1.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Organic matter (wood, etc)</td>
<td></td>
<td></td>
<td>max 0.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asbestos and hazardous</td>
<td></td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 1141.52</td>
<td>Maximum dry compressive strength on fraction passing 19 mm sieve (only applies if plasticity index is less than 1)</td>
<td>min 1.0 MPa</td>
<td>min 1.0 MPa</td>
<td>min 1.0 MPa</td>
<td>min 1.0 MPa</td>
<td>min 1.0 MPa</td>
</tr>
<tr>
<td>AS 1141.14</td>
<td>Particle shape by proportional calliper - % misshapen (2:1)</td>
<td>max 35%</td>
<td>max 35%</td>
<td>max 35%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Aggregate wet strength*</td>
<td>min 50 kN</td>
<td>min 50 kN</td>
<td>min 50 kN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Wet/dry strength variation* (dry - wet/dry)</td>
<td>max 40%</td>
<td>max 40%</td>
<td>max 40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 1141.23</td>
<td>Los Angeles value</td>
<td>max 40%</td>
<td>max 40%</td>
<td>max 40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 1289.6.1.1</td>
<td>4 day soaked CBR (94% modified compaction)</td>
<td>min 30%</td>
<td>min 30%</td>
<td>min 30%</td>
<td>min 30%</td>
<td>min 30%</td>
</tr>
</tbody>
</table>

NOTES:
* All fractions of the proposed mix must satisfy this requirement. Use the fraction with the highest wet/dry strength variation as the value for determining conformance. Test the fraction 19.0 mm to 9.5 mm. In the case of blended materials, also test the fraction 9.5 mm to 4.75 mm. Test any other fraction which is at risk of failing, in the opinion of the Superintendent.

3.2 MODIFIED TEXAS TRIAXIAL CLASSIFICATION

Alternative materials

Requirement: Submit proposal for the use of any unbound base or subbase material that conforms to the requirements of the Base material properties table or Subbase material properties table, except for the particle size distribution grading to AS 1289.3.6.1.

Proposed material: Submit details of the proposed material including evidence of modified Texas triaxial classification and associated tests.

Submission: HOLD POINT.
Test
Method: RMS T171.
Requirements: To the Modified Texas triaxial classification number requirements table.
RMS T171 tested: At 83 - 87% of Optimum Moisture Content and 99 – 101% of Maximum Dry Density as determined by AS 1289.6.1.1.

<table>
<thead>
<tr>
<th>Material class</th>
<th>Modified Texas triaxial classification number (RMS Test Method T171)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>max 2.5</td>
</tr>
<tr>
<td>Subbase</td>
<td>max 3.2</td>
</tr>
</tbody>
</table>

3.3 LIME MODIFIED BASE AND SUBBASE MATERIALS

Lime modification
Proposal: Submit details of any proposed addition of hydrated lime, including details of any initial consumption of lime test, to modify unbound base and subbase materials to meet the requirements of UNBOUND BASE AND SUBBASE MATERIALS. This is a HOLD POINT.
Modification: Uniformly mix with hydrated lime, in a stationary mixing plant, at the supplier’s quarry.
In-situ lime modification
Alternative: Submit details of any proposed in-situ addition of hydrated lime or quicklime.
Submission: HOLD POINT.
Method: To 1113 Stabilisation.

Material requirements
Before lime treatment: Provide material with no added pozzolanic material.
Lime: Hydrated lime and quicklime to 1113 Stabilisation.
Proportion of lime: Not less than 1.5% nor more than 4%, by mass, after initial consumption of lime requirements have been met.
CRB20 before treatment with lime: Material to conform to the requirements of CRS20 in the Subbase material properties table and the following:
- Aggregate wet strength > 80 kN.
CRB20 material after lime treatment: CBR ≥80, when tested to AS 1289.6.1.1. Perform sampling within 24 hours of adding the lime and test after 7 days accelerated curing.

Unconfined compressive strength
Testing: UCS < 1.0 MPa, when tested to AS 5101.4. Perform sampling within 24 hours of adding the lime and test after 7 days accelerated curing.

3.4 BOUND BASE AND SUBBASE MATERIALS (REFER TO NOTE UNDER CLAUSE 3.1)

General
Requirement: Supply bound material as a crushed rock product with stabilising agent incorporated in a pugmill.
Stabilising agent: Materials to conform to Austroads AGPT04D and 1113 Stabilisation.

Bound base
Base material requirements before stabilisation: To the Subbase material properties table.

In situ stabilisation
Alternative: Give notice if in-situ stabilisation of natural or blended gravel by mobile plant at site is proposed.
Proposal: WITNESS POINT.

Unconfined compressive strength
Testing: UCS > 3 MPa when tested to AS 5101.4. Perform sampling within 1 hour of adding the stabilising agent and test after 7 days accelerated curing.
4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 DELIVERY

Transport of materials
Delivery vehicles: Provide enclosure to avoid loss of material during transit.
Condition: Provide materials sufficiently damp to avoid segregation and loss of fines during transit.
Moisture content: Uniformly distributed so that the moisture content is less than the optimum moisture content to AS 1289.5.1.1, AS 1289.5.2.1 or AS 1289.5.7.1. Alternatively, the moisture content may be specified by the Superintendent ± 0.5%.

Delivered materials
Notice: Give notice of arrival of materials for inspection.
Inspection: WITNESS POINT.

Delivery of modified or bound materials
Time period: Program the delay between mixing and delivery, to allow incorporation into the works, including trimming and compaction, within the nominated field working period.
Proposal: WITNESS POINT.

Delivery dockets for bound material
Identification: Identify each truck load of bound material by delivery dockets, indicating the time and date of mixing and registration or fleet number of the delivery truck. Provide delivery dockets for inspection at the point of delivery.
Inspection: WITNESS POINT.

4.3 STOCKPILING UNBOUND MATERIAL

Location
Stockpile sites: Locate stockpile sites as shown on the drawings or give notice of proposed alternative locations.
Proposal: WITNESS POINT.

Preparation
Condition: Clear stockpile sites of all vegetation and extraneous matter, and shape to form a crown to allow area to drain freely. Compact the area to a relative compaction ≥95%, to AS 1289.5.4.1 for standard compactive effort.

Stockpile maintenance
Stockpile height: < 3 m.
Side slopes: Uniform shape with side slopes not steeper than 1.5H:1V or flatter than 3H:1V.
Moisture content: Maintain stockpiled material at a moisture content sufficient to avoid loss of fines.
Contamination of materials: Maintain stockpiles and stockpile sites to make sure materials do not become intermixed, segregated or contaminated with foreign material.

Restoration
Surplus material: Upon completion of the works, clear stockpile sites of all surplus material and leave in a clean and tidy condition.

Sampling
Test: Sample and test stockpiles within 3 days of delivery to AS 1141.3.1 and as directed by the Superintendent.

4.4 SPREADING

General
Joints: At all work boundaries in bound materials, provide vertical faces for transverse and longitudinal joints.
Transverse joints: Locate at a minimum offset of 2 m from any joint in layer below.
Longitudinal joints: Locate along lane marking line or mid-way between lane marking lines. Offset a minimum of 100 mm from any joint in layer below.
Moisture content when spreading: > 85% of the laboratory optimum moisture content, to achieve specified compaction to AS 1289.5.2.1.

Underlying layer
Requirement: Moisture content < 80% of the laboratory optimum moisture content, to AS 1289.5.2.1, and free from rutting or foreign matter.
Quality: Before spreading of base and subbase material, give notice so that inspection may be made of the underlying layer quality including the assessment of required moisture content.
Inspection: HOLD POINT.

Non-conforming underlying layer
Correction: If Contractor activities cause the underlying layer to become non-conforming, correct the underlying layer to conform to this worksection. The cost shall be borne by the Contractor.

Temperature
Requirement: Spread material when ambient air temperature is between 5°C and 35°C in the shade.
Outside temperature range: Submit proposals to spread bound materials when temperatures are outside the required ambient air temperature range.
Submission: HOLD POINT.

4.5 TRIMMING, COMPACTION AND CURING

Compaction
Process: Spread, shape and compact each layer in uniform thicknesses. Trim layer to conform to the documented thickness.
Compacted layer thickness: 200 mm maximum and 100 mm minimum. Provide layers of equal thickness in multilayer courses. Give notice of the proposed use of any layer thickness outside of this range.
Proposal: WITNESS POINT.

Compaction procedure
Conformance: Uniformly compact each layer of the base and subbase courses over their entire area and depth conforming to ACCEPTANCE OF COMPACTION.
Moisture content: Maintain at > 85% of the laboratory optimum moisture content during compaction.
One-way crossfall sections: Compact from the low side to the high side.
Crowed sections: Compact from edge to crown on each side of the pavement.
Rollers: Pass parallel to the centreline of the pavement and uniformly overlap each preceding pass.
Sides: Minimum 2 additional passes of roller, for outer 1 m width of pavement on both sides.

Plant
Protection: Do not stand watering and compaction plant on the pavement being compacted.
Self propelled plant: Use self propelled compaction plant, where practical.
Hand operated plant: Submit details of any hand operated compaction plant proposed for use.
Submission: HOLD POINT.

Subsequent layers
Tests: Do not place subsequent layers until all required testing has been completed and the test results for each layer have been submitted.
Submission: HOLD POINT.

Rework
Wetted up layers: If an unbound layer becomes wetted up after compaction is complete, dry out and give notice for inspection. If necessary, uniformly re-compact and trim to the documented density requirements and level tolerances.
Inspection: WITNESS POINT.

Unstable areas
Rejection criteria: Any unstable areas that develop during rolling or are identified by proof rolling.
Dry back and replacement: Open up, dry back and re-compact, to the requirements of this worksection. If dry back is not possible, remove the full depth of layer, dispose of and replace with fresh material to conform to REMOVAL AND REPLACEMENT OF REJECTED COURSES.

Curing of bound materials
Timing: Commence curing of the surface layer of a lot immediately after compaction is completed.
Requirement: Keep stabilised work continuously wet or damp to prevent rapid drying out before placement of the subsequent layer or the application of a prime or primersal.
Procedure: Provide frequent light uniform water spray without significant run off or flooding. Avoid slurring of the surface or leaching of the stabilising agent. Give notice of water curing activities for inspection.

Inspection: WITNESS POINT.

4.6 ACCEPTANCE OF COMPACTION

Lots for acceptance
Acceptance of work: Based on density testing of the work in lots.
Lots: Nominate lots as follows:
- Extent: A single layer of work, constructed under uniform conditions in a continuous operation, not crossing any transverse construction joints.
- Unbound materials: Equal to a day's output using the same material.
Density testing: Submit results verifying the required relative compaction has been achieved.
Submission: HOLD POINT.

Compaction requirements and acceptance
Lot compaction acceptance: Minimum relative compaction for modified compactive effort is ≥97%.
Alternative compaction acceptance: For bound layers any zones with relative compaction < 97% (modified compactive effort) but ≥92% may be accepted provided evidence is submitted to show that such zones constitute less than 5% of the lot.
Submission: HOLD POINT.

Relative compaction using in-situ dry density
Sampling frequency: Ten tests per 5000 sq m with a minimum of 3 tests per lot or as directed. Method: Calculate the relative compaction of pavement material, at each location tested for in-situ dry density, to AS 1289.5.4.1 as follows:
- Relative Compaction % = [(In-situ dry density)/(Comparative dry density)]×100.
Comparative dry density: Equal to the following:
- Unbound layers: The maximum dry density (modified compactive effort) determined in the laboratory by testing samples to AS 1289.5.2.1.
- Bound layers: The maximum dry density (modified compactive effort) determined by testing samples to RMS T130 within two hours of the addition of the stabilising agent to the mix.
In-situ dry density: Test the compacted material to AS 1289.5.3.2.

Nuclear density meter testing
Alternative: A single probe nuclear density meter may be used in the direct transmission mode, to AS 1289.5.8.1, for some or all of the in-situ dry density testing. Give notice of proposal to use Nuclear Density Meter.
Proposal: WITNESS POINT.

Corrective action – Rejected layers
Unbound layers: Rework lots that have been rejected in regard to compaction and resubmit for compaction assessment.
Bound layers: Remove rejected bound layers.
Costs: All costs associated with corrective works carried out before the resubmission of a lot for assessment, including rewatering, rerolling, removal and replacement of material as well as reworking shall be borne by the Contractor.

Removal
Replacement: Remove rejected bound layers and any unbound material which in the opinion of the Superintendent, has become degraded, segregated or otherwise reduced in quality by reworking.
Dispose of and replace with fresh material to conform to REMOVAL AND REPLACEMENT OF REJECTED COURSES.

4.7 ACCEPTANCE OF DIMENSIONS AND LEVELS

General
Acceptable limits: Documented tolerances are acceptable limits of departure from the dimensions shown on the drawings, which may occur during construction.
Lots: Conform to the maximum lot size and minimum test frequencies in 0161 Quality (Construction).
Survey reports: Submit survey reports covering line and level for each lot.
Submission: HOLD POINT.

Layer width
Tolerance: Zero to + 100 mm of the design widths for both base and subbase, measured from the design centre line to the edge of the constructed pavement base/subbase layer but limited to 50 mm per side and as shown on the drawings. Give notice for inspection of completed layer width.
Inspection: WITNESS POINT.

Surface level
Surface: Parallel to the proposed finished wearing surface after final compaction and trimming of both base and subbase layers.

Subbase surface deviation
Tolerance: + 10 mm, - 25 mm from design level, after trimming. Give notice for inspection of completed subbase surface.
Inspection: WITNESS POINT.

Base surface deviation
Tolerance: + 10 mm, - 5 mm from design level or ± 5 mm from a 3 m long straightedge laid in any direction, after trimming and immediately prior to sealing. Give notice for inspection of completed base surface.
Inspection: WITNESS POINT.

Base adjacent to kerb and gutter
Tolerance: ± 5 mm of the level of the lip of the gutter, minus the design thickness of the wearing surface. Give notice for inspection of completed base surface.
Inspection: WITNESS POINT.

Corrective action – Rejected unbound layers
Trimming: Submit proposal to correct surface by trimming without filling, to produce a uniform, hard surface.
Submission: HOLD POINT.

Corrective action – Rejected bound layers
Design level: Corrective action may be approved where:
- The subbase course is lower than the design level with tolerances. Submit proposal to increase the thickness of the base course to make up such deficiency in thickness.
- The subbase course is above the design level with tolerances. Submit proposal to regrade the design level of the base course, to allow for laying of its design thickness, up to a maximum of 20 mm above the original design level.
- The base course is above the design level with tolerances. Submit proposal to regrade the design level of the base course.
Submission: HOLD POINT.

Approved corrective regrading: Conform to the following:
- A rate of change of grade from the original finished design surface level of less than 3 mm per metre.
- The proper design function of the drainage system.
- Existing levels at property boundaries, without increasing or decreasing footpath or footpath crossover levels or grades beyond Council's allowable design limits.
- Clearances.
Costs: The costs associated with surface level corrections required by this Clause shall be borne by the Contractor.

Removal
Replacement: If corrective action is unachievable, remove and dispose of material and replace with fresh material to conform to REMOVAL AND REPLACEMENT OF REJECTED COURSES.

4.8 REMOVAL AND REPLACEMENT OF REJECTED COURSES

Extent of removal
Requirement: Remove rejected material over full length of rejected lot.

Exception: Submit proposal to remove less than the full width, as constructed, if the cause of rejection can be isolated. Form a new longitudinal cold joint located along the centreline of the road pavement.
Submission: HOLD POINT.

Prior to replacement
Inspection: Give notice of completion of removal of rejected base or subbase, for inspection before commencement of replacement works.
Inspection: HOLD POINT.

Replacement
Materials: Provide materials for replacement works, including spreading, compaction, trimming, curing and test the replacement materials, to conform to the requirements of this worksection.

Damage: Submit proposed methods to make good any damage to underlying or abutting layers or structures due to the removal or replacement of rejected courses.
Submission: HOLD POINT.

Costs: All costs associated with removals, replacements and corrections of base and subbase courses required under this Clause and the extra costs incurred by the Contractor in respect of delays caused by such removals, replacements and corrections shall be borne by the Contractor.

4.9 MAINTENANCE BEFORE COMPLETION OF WEARING SURFACE

Dry back
General: Allow material to dry back to 60% to 80% of the optimum moisture content before applying the primerseal or wearing surface

Primerseal
Prepared surface: Maintain the accepted condition of the base course until the wearing surface is completed.

Extent: Within 7 days of acceptance of a lot, cover the base course with a primerseal, over the full width, to 1143 Sprayed bituminous surfacing. Give notice of any alternative procedure proposed.
Proposal: WITNESS POINT.

Pavement condition before primerseal
Restore condition: If the base condition deteriorates before primerseal application and approval to proceed with bitumen surfacing work is withdrawn, dry-back and re-prepare the base. Submit evidence of dry-back being achieved and give notice for inspection.
Inspection: HOLD POINT.

Surface drainage
Ponded water: Maintain adequate drainage of the pavement before completion of the wearing surface and remove any ponded water within 12 hours if free drainage is not achievable.

Restrictions on movement
Limits: Only vehicles registered for road use and loaded within legal limits are permitted to use the pavement.

Bound pavements: Prevent construction plant and vehicles not involved in current construction or testing activities from using the pavement within 7 days of placement of the base course and before the application of primerseal.
Unbound pavements: Prevent construction plant and vehicles not involved in current construction or testing activities from using the pavement before the application of primerseal. Give notice if this requirement is impractical.

Notification: WITNESS POINT.
Opening bound pavement to traffic
Timing: Traffic not permitted to use pavement within 7 days of completion of full pavement depth and application of primer seal. Give notice of proposed opening to traffic.
Notification: HOLD POINT.
Costs: the costs of re-preparing areas of deteriorated pavement shall be borne by the Contractor.

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this work section, the drawings and pay items 1141.1 and 1141.2 inclusive.
Lump sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
- Base course primer密封: In conformance with 1143 Sprayed bituminous surfacing.

5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay Items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
</table>
| 1141.1 Supply, spread and compact subbase course | m² | - The area is determined by the length and width of work as specified on the drawings or as directed by the Superintendent. 
- For total relevant thickness shown on the drawings. |
| | | Take no account of allowable tolerances. 
All costs associated with all documentation and approvals and: 
- Supply, spread, compaction, trimming, jointing, and testing of the subbase course, and curing of bound material. |
| 1141.2 Supply, spread and compact base course | m² | - The area is be determined by the length and width of work as specified on the drawings or as directed by the Superintendent. 
- For total relevant thickness shown on the drawings. |
| | | Take no account of allowable tolerances. 
All costs associated with: 
- Supply, spread, compaction, trimming, jointing, and testing of the base course, and curing of bound material. |
143 SPRAYED BITUMINOUS SURFACING

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide sprayed bituminous surfacing for roads and related applications, as documented, comprising:

- Prime.
- Primerseal.
- Seal:
  - With conventional bitumen, cutback bitumen or bitumen emulsion binder.
  - With modified binder, e.g. multigrade binder, polymer modified binder.
  - Incorporating geotextile fabric, with or without modified binder.

Design
- design details and all the design parameters for the project are set out in the design documentation.
- Materials: Accredited RP & CPE or alternatively listed on the AAPA (Australian Asphalt Pavement Association) Sprayed Seal Design Registry as having successfully completed the assessment.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following work section(s):
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this work section by reference:

Note: Only the most current standards are to be used

AS 1160 Bituminous Emulsions for Construction and Maintenance of Pavements
AS 1742 Manual of uniform traffic control devices,
AS 1742.3 Traffic control devices for works on roads
AS 2008 Residual bitumen for pavements
AS 2124 General conditions of contract
AS 2157 Cutback Bitumen
AS 2758 Aggregates and rock for engineering purposes
AS 2758.2 Aggregate for sprayed bituminous surfacing
AS 3568 Oils for reducing the viscosity of residual bitumen for pavements
AS/NZS ISO 9001 Quality Management Systems – Requirements

Other publications
Note: Only the most current standards are to be used

AAPA
AAPA HS&E Guide No 8 Guide for Environmental Management when Spraying Bituminous Materials
AAPA Guide to the Selection, Heating and Storage of Binders for Sprayed Sealing and Hot Mixed Asphalt
ASTM D6140 Standard test method to determine asphalt retention of paving fabrics used in asphalt paving for full width applications

AUSTROADS
1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions in AP-C87 and those given below apply.

- Binder: A material used in the mix to improve temperature susceptibility, response to transient loads and cohesive strength.
- Cutter oil: A light petroleum distillate (e.g. kerosene) added to bitumen to temporarily reduce its viscosity.
- Double/double seal: A seal consisting of two successive applications of binder each followed by an application of aggregate.
- Flux Oil: A petroleum distillate (e.g. diesel) added to bitumen to produce a long-term reduction in viscosity.
- Prime: An application of a primer to a prepared base, without cover aggregate.
- Primer: A bituminous material of low viscosity and low surface tension used in priming.
- Primerseal: An application of a primerbinder with a cover aggregate to a prepared base.
- Primerbinder: A material, more viscous than a primer, and required to act both as a primer and binder, and used in primersealing.
- Seal: A sprayed application of bituminous binder into which aggregate is incorporated. A sprayed seal may incorporate more than one application of binder and aggregate and may also be combined with a layer of geotextile fabric.
- Reseal: A seal applied to an existing sealed, or asphalt surface.
- Residual Binder: The volume of bituminous binder at 15°C including the volume of any polymer, crumb rubber and flux oil but not including the volume of any cutter oil, water, emulsifier or adhesion agent.
- Single/double seal: A seal consisting of a single application of binder followed by a double application of aggregate.
- Single/single seal: A seal consisting of a single application of binder followed by a single application of aggregate.
- High Stress Seal or Reseal (HSS): The application of a polymer modified binder into which aggregate is incorporated to provide a durable wearing surface.
- Strain Alleviating Membrane (SAM): The application of polymer modified binder into which aggregate is incorporated to provide a durable wearing surface with strain alleviating or other desirable properties.
- Strain Alleviating Membrane Interlayer (SAMI): The application of a polymer modified binder into which aggregate is incorporated. A SAMI is used as an interlayer between an asphalt wearing course and underlying layers to provide alleviation from tensile strains developed beneath it.
- Geotextile Reinforced Seal (GRS): The applications of C170 tack coat, geotextile or polymer modified binder into which aggregate is incorporated to provide a durable wearing surface with strain alleviating or other desirable properties.
- RMS- Roads and Maritime Services.
1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

Documents
Submit the following for approval:
- Materials: Refer to material clauses.
- Drawings: Prepare drawings or other documentation to record extent and constitution of final works.
- Execution details: In conformance with workssection requirements.

Design of sprayed seals
Submit the design of sprayed seals as follows:
- The types of sprayed seal treatment as shown on drawings.
- Determine rates of application of binder and aggregate for the nominated sprayed seal treatment types based on Austroads Sprayed Sealing Guide. If specified, submit the seal design for assessment by the Superintendent for compliance with the requirements of this workssection. This is a WITNESS POINT.

Materials and application rates: The selection of materials and application rates for surfacing treatments not covered by the Austroads Seal Design Method, such as priming, primersealing and special treatments, to be in conformance with guidelines for accepted good practice.

1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause title/item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRE-CONSTRUCTION PLANNING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling and testing</td>
<td>Quality plan to nominate testing frequency</td>
<td>2 weeks before testing materials</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Traffic management</td>
<td>Submit a traffic management plan for approval</td>
<td>3 weeks before commencing site work</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td>Plant</td>
<td>Evidence that plant is registered and insured</td>
<td>2 weeks before using plant</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

WITNESS POINTS table – On-site activities

<table>
<thead>
<tr>
<th>Clause title/item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENERAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submissions, Design</td>
<td>Submit the sprayed seal design for approval</td>
<td>2 weeks before commencing work</td>
</tr>
<tr>
<td>MATERIALS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aggregate</td>
<td>Source of materials submit for approval</td>
<td>3 weeks before commencing work</td>
</tr>
<tr>
<td>Removal of loose aggregate, Loose aggregate particles</td>
<td>Completion within specified time</td>
<td>Various to allow inspection of performance in conformance with Tables of time limits</td>
</tr>
<tr>
<td>Removal of surplus and waste material</td>
<td>Demonstrate that materials are properly disposed</td>
<td>Progressive</td>
</tr>
<tr>
<td>Protection, New work</td>
<td>Demonstrate that line marking and warning signs are in place to protect new work</td>
<td>Progressive</td>
</tr>
</tbody>
</table>
2 PRE-CONSTRUCTION PLANNING

2.1 GENERAL

Proposed testing frequency
Quality plan: Nominate in the Quality plan the proposed testing frequency including, but not limited to:

- Specification compliance of bituminous materials.
- Specification compliance of aggregates.
- Measurement of loose aggregate on completed work. This is a HOLD POINT.

Traffic management
Plan: Submit a Traffic Management Plan for approval. Provide for traffic in conformance with 1101 Control of traffic while undertaking the work and include the following:

- Supply of labour and materials to 1101 Control of traffic.
- Avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the employees and the road users. This is a HOLD POINT.

Plant
Registration and insurance: Provide for all plant as appropriate to its use on a public road.
Operation: Conform to statutory environmental regulations. This is a HOLD POINT.

3 MATERIALS

3.1 BITUMINOUS MATERIALS

Bitumen
Bituminous binders: To AGPT04F.

Polymer modified binders

Bitumen emulsion
Bitumen emulsion: To AS 1160.

Cutback bitumen
Cutback bitumen: To AS 2157 or may be prepared by the Contractor, in the field, by blending bitumen and cutback oil in proportions documented or selected as appropriate to the particular application.

Proprietary grades of cutback bitumen: To the manufacturer's specification.

Adhesion agent
Type and proportion: Add the type and proportion of adhesion agent to bituminous binder or aggregate precoating material subject to either of the following:

- Evidence provided of previous satisfactory performance with the proposed combination of binder, aggregate source and precoating material.

- Selection from materials listed as approved by the relevant state road authority (if applicable).

Cutter oil and flux oil
Cutter oil and flux oil: To AS 3568.

Aggregate precoating materials
Aggregate precoating materials: Flux oil, flux oil and bitumen mixture, cutback bitumen, proprietary bitumen emulsion or other proprietary product are subject to evidence of previous satisfactory field performance as an aggregate precoating material. All precoating material to contain a minimum of 1% of an approved adhesion agent.

3.2 AGGREGATE

General
Source: The source of all materials is subject to inspection and approval by the Superintendent. Only use material from a nominated quarry face or location. This is a WITNESS POINT.
Aggregate: To AS 2758.2 with the following additional requirements:
- Specify the class of aggregate, resistance to polishing, method of determination of aggregate shape, and combination of hardness and durability test measures as detailed in the approved CC drawings.
- Apply only one method of determination of aggregate shape and one combination of hardness and durability.
- If no aggregate details are specified as detailed in the approved CC drawings select the particular aggregate class, polishing resistance and combination of test methods based on the service conditions and customary test procedures used in NSW.

3.3 OTHER MATERIALS

Protective paper
Heavy duty protective paper: Use a heavy-duty protective paper, weighing not less than 120 gm/m², for all start, finish and taper operations. Ensure that the paper is of sufficient width to prevent overspray and of sufficient strength to prevent spillage during removal.

Geotextile
Properties: Geotextile fabric used in geotextile reinforced seals:
- Non-woven.
- Needle punched fabric:
  - Minimum melting point 190°C.
  - Minimum mass 130 g/m².

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 APPLICATION

General
Application: Adopt Annexure A for procedure.
Scope: Provide the following:
- Supply and delivery of materials.
- Storage and handling of raw materials.
- Precoating of aggregate (if aggregates are not purchased suitably precoated).
- Preparation of bituminous materials, including selection and incorporation of appropriate proportions of cutter oil, adhesion agent and any other additives. To Austroads AP-T42/06.
- Control of traffic through the works, including recording of traffic control measures.
- Removal and disposal, or protection, of existing raised pavement markers.
- Sweeping and cleaning pavement surfaces prior to spraying.
- Protection of road furniture from spray.
- Supply and placing of geotextile, as documented.
- Application of primer, primerbinder and/or binder, uniformly to the target application rate.
- Spreading of aggregate, uniformly to the target application rate.
- Rolling of aggregate.
- Removal of loose aggregate
- Removal and disposal of all surplus and waste materials.
- Installation of temporary pavement markers.
- Care of completed work.
Performance: In conformance with recognised industry standards, AGPT04K, including the following:
- Completed and cured primes to have a uniform appearance.
- Completed primerseals and single/single seals with aggregates of 7 mm size, or less, to have a uniform surface retaining a matrix of aggregate.
- Completed single/single seals with aggregates of 10 mm size, or greater, to have a uniform, single retained layer of aggregate.
- Completed single/double seals to have a uniform layer of retained aggregate with both sizes fitting together to produce a uniform surface texture.
- Completed double/double seals to have uniform double retained layers of aggregate with the second aggregate fitting inside the texture of the aggregate used in the first layer.
- Finished work to have clean straight edges and no obvious defects related to poorly constructed longitudinal or transverse joins, blocked spray nozzles or any other construction fault.

4.3 TESTING

Laboratory testing
Requirements: Test the properties required by the worksection as follows:
- Perform in a laboratory registered by the National Association of Testing Authorities (NATA) or International Accreditation New Zealand (IANZ) for the appropriate tests. Perform in conformance with procedures contained in the relevant Australian or New Zealand Standard or Austroads Manual of Test Procedures.
- If there is no applicable Australian Standard or Austroads Test Method or if the Standard/Manual provides a choice of procedures, adopt a procedure endorsed by the relevant state road authority in the State in which the work is being undertaken.

Exceptions: Requirements for NATA or IANZ registration do not apply to field tests such as surface texture measurements or aggregate spreader calibration undertaken by competent and trained personnel.

4.4 REMOVAL OF LOOSE AGGREGATE

Loose aggregate particles
Extent: After final sweeping, and prior to removal of speed restriction and warning signs, the number of loose aggregate particles remaining on the surface of seals constructed with 10 mm, or larger, aggregates not to exceed the values specified in Loose stone particles remaining after sweeping table.

Windrow aggregate: Remove any windrow of aggregate on either the sealed surface or shoulder that could constitute a traffic hazard. If documented, uplift and remove from the works all surplus aggregate.

Timing: Complete the removal of loose aggregate from the trafficked pavement within the time specified in Time limit for removal of loose aggregate table. This is a WITNESS POINT.

Loose stone particles remaining after sweeping table

<table>
<thead>
<tr>
<th>Road type</th>
<th>Loose stones (particles/m²) max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban areas</td>
<td>20</td>
</tr>
<tr>
<td>Other medium to high traffic (&gt; 250 v/l/d)</td>
<td>30</td>
</tr>
<tr>
<td>Low traffic (&lt; 250 v/l/d)</td>
<td>40</td>
</tr>
</tbody>
</table>

Time limit for removal of loose aggregate table

<table>
<thead>
<tr>
<th>Traffic volume (vehicles/lane/day)</th>
<th>Maximum time limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2000 and all freeways</td>
<td>Within 8 hours of sealing</td>
</tr>
<tr>
<td>1000 to 2000</td>
<td>Within 24 hours of sealing</td>
</tr>
<tr>
<td>250 to 1000</td>
<td>Within 48 hours of sealing</td>
</tr>
<tr>
<td>&lt; 250</td>
<td>Within 5 days of sealing</td>
</tr>
</tbody>
</table>
4.5 REMOVAL OF SURPLUS AND WASTE MATERIAL

Cleaning
Completion: Prior to leaving the work site, ensure that all services are uncovered and cleaned, if necessary. Remove from site all waste paper and rubbish arising from the sprayed sealing operations. Clean the stockpile site and remove. This is a WITNESS POINT.

4.6 PROTECTION

New work
Warning signs: Protect the new work by providing signage as follows:
- Provide signs to warn public of loose stones and absence of line marking including provision of temporary raised pavement markers.
- Maintain signs until loose aggregate has been removed and linemarking reinstated.
- If linemarking is to be undertaken by others, erect warning signs indicating the absence of linemarking to be maintained by the organisation responsible for linemarking. These activities are a WITNESS POINT.

Services and road Fixtures
Protection: Take all necessary precautions to prevent primer, primerbinder, binder, aggregate or other material used on the work from entering or adhering to gratings, hydrants or valve boxes, manhole covers, bridge or culvert decks and other road fixtures.

Cleaning: Immediately after aggregate has been spread, clean off or remove any sprayed material and leave the services and road fixtures in a condition equivalent to that existing when the sprayed surfacing work commenced.

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT BY AREA OR LENGTH

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1143.1 Priming, primer sealing or sealing</td>
<td>m² Area</td>
<td>No deductions for openings each not exceeding 1 m². All costs associated with priming, primer sealing or sealing.</td>
</tr>
<tr>
<td>1143.2 Removal and disposal of existing raised pavement markers</td>
<td>Measured by length in kilometres</td>
<td></td>
</tr>
</tbody>
</table>

5.2 MEASUREMENT BY QUANTITY OF MATERIAL SUPPLIED

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1143.3 Supply and spray primer or primer binder (including preparation of surface) @ 15ºC</td>
<td>Litres</td>
<td>All costs associated with the preparation of surface and supply and spray primer or primebinder</td>
</tr>
<tr>
<td>1143.4 Supply and spray</td>
<td>Litres</td>
<td>All costs associated with the</td>
</tr>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td>binder (including adhesion agent where required, and preparation of surface) @ 15°C</td>
<td>Determine the quantities (in litres) by either: - Multiplying the target application rate of the residual (excluding any cutter oil or flux oil) at 15°C (in litres/m²) by the area of road surface sprayed for each sprayer run (in m²); or - Measurement of actual volume (at 15°C) of materials used.</td>
<td>supply and spray binder.</td>
</tr>
<tr>
<td>1143.5 Supply, incorporate and spray cutter oil, flux oil and adhesion agent in binder at ambient temperature or 15°C</td>
<td>Litre Determine the quantities from either: - The target proportion of cutter, oil flux oil, or adhesion agent added to the binder; or - Measurement of actual volume of materials used.</td>
<td>All costs associated with the supply of cutter oil, flux oil and adhesion agent in the binder.</td>
</tr>
<tr>
<td>1143.6 Supply, precoat, apply aggregate</td>
<td>m³ - Volume. - Determine the quantity of aggregate (in m³) by dividing the area of road surface covered by each sprayer run (in m²) by the target application rate (in m²/m³)</td>
<td>All costs associated with the supply, precoat and application of aggregate.</td>
</tr>
<tr>
<td>1143.7 Roll and incorporate aggregate</td>
<td>m²</td>
<td>All costs associated with the rolling of aggregate.</td>
</tr>
<tr>
<td>1143.8 Supply and place geotextile</td>
<td>m² - Pavement area covered</td>
<td>All costs associated with the supply and placement of geotextile to exclude laps and application of binder and aggregate.</td>
</tr>
<tr>
<td>1143.9 Sweeping</td>
<td>m²</td>
<td>All costs associated sweeping prior to seal and post seal</td>
</tr>
</tbody>
</table>

5.3 RESERVED
7 ANNEXURE A: PROCEDURE FOR PERFORMING SPRAYED SEALING WORKS

7.1 GENERAL

This section details the procedure, based on good practice, to achieve satisfactory outcomes and durable performance from sprayed sealing work. The following procedures may be incorporated in the Contractor’s Quality Plan or provide a benchmark for assessing the effectiveness of the process standards adopted by the Contractor.

7.2 STORAGE AND HANDLING OF RAW MATERIALS

Aggregates
Requirement: Arrange and manage aggregate stockpiles in conformance with the following requirements:
- The maximum lot size limited to 250 m³ (approximately 300 tonnes).
- Stockpiles each located on a firm level ground and effectively separated to prevent cross-contamination and interfere with the loading and/or precoating operations.
- Siting of stockpiles ensure adequate clearance between machinery and overhead power lines.
- Stockpiles managed to avoid environmental damage from dust or run-off of bituminous materials.
- The quantity and type of each stockpile clearly signposted on the stockpile at all times.
- Stockpiles covered, if necessary, to reduce contamination by dust or water.
- Recovery from stockpiles is to avoid contamination of aggregates.
- Contamination, weathering or reduction in effectiveness of precoating of aggregates in stockpiles to be rectified or the stockpile replaced.

Binder
Heating of binder: Heat binder in conformance with the manufacturer's written recommendations but never exceed 200°C. Do not use any bituminous material that has been overheated unless tested for compliance with the relevant specification. If no specific recommendation is provided, adopt the temperature guidelines set out in AAPA-2003.

Storage: Store binder in conformance with the temperature and time combinations specified in the manufacturer's written recommendation. Implement procedures for storage and handling of binder that ensure prevention of segregation and contamination of the binder by flushing liquids or other materials. Use straining devices at all times when transferring binders into sprayers to avoid particles of hardened bituminous material or other contaminants that could cause blockages in spraying jets.

7.3 CONDITION FOR COMMENCEMENT

Acceptance of surface condition
Inspection: Prior to commencing sprayed sealing work, make an inspection to determine any pavement defects that could adversely affect the quality of the finished work. Sprayed sealing work is not to proceed until defects have been corrected or agreement reached with the Superintendent's Representative on responsibility for consequences of any recorded defects.

Defects requiring correction may include, but are not limited to:
- Excessive moisture in unbound granular base to be prime or primersealed.
- Loose, poorly bonded, or inadequately compacted materials in the surface of unbound granular base to be prime or primersealed.
- Poorly shaped unbound granular base to be prime or primersealed.
- Presence of soft, fatty or bleeding patches in pavements to be resealed.
- Presence of uncured patching materials, crack sealing, etc.
- Presence of porous patches in surface to be resealed.
- Significant variations in surface texture requiring corrective treatment before resealing.
- Inadequate repair of weak or cracked pavements.
- Inadequate curing of primed surfaces prior to sealing.
- Inadequate curing of primersealed pavements (generally a minimum of 12 months for cutback bitumen primerbinders) prior to resealing.
Preparation of pavement surface
Surface preparation: Before the application of primer, primerbinder or binder, sweep pavement surface by the use of a rotary road broom or suction broom to provide a uniformly clean surface. If necessary, do additional sweeping by hand, using stiff brooms. Extend sweeping at least 300 mm beyond each edge of the area to be sprayed. If sealing work is carried out on localised areas and/or half pavement widths, remove from the pavement surface any remaining loose material immediately adjacent to the swept areas.
Remove adherent patches of foreign material from the surface of the pavement. Remove raised pavement markers.

Pavement temperature and weather conditions
Record of weather conditions: Conform to the following:
- Measure and record pavement temperatures at regular intervals during the course of the work using appropriate equipment and measurement procedures.
- If the pavement is partly in sun and partly in shade, record the temperatures for both conditions. The lower recorded temperature to be used as a basis for decisions on suitability for spraying and selection of cutter oil proportions.
- Spraying primers, primerbinders and binders only if the pavement temperature has been at or above for the temperature shown in Table A1 at least one hour before commencement of spraying and does not fall below the recommended minimum pavement temperature during the period of spraying.
- Spray at temperatures below that recommended only if the risk of poor bitumen adhesion can be adequately managed through suitable type and proportion of cutter oil, traffic control, speed of aggregate covering, rolling and aftercare of completed work.

<table>
<thead>
<tr>
<th>Type of work</th>
<th>Minimum pavement temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priming</td>
<td>10°C</td>
</tr>
<tr>
<td>Primersealing</td>
<td>10°C</td>
</tr>
<tr>
<td>Sealing:</td>
<td></td>
</tr>
<tr>
<td>- Class 170, Class 320 bitumen, Multigrade binder or bitumen emulsion</td>
<td>15°C</td>
</tr>
<tr>
<td>- PMB binder (hot)</td>
<td>20°C</td>
</tr>
</tbody>
</table>

Surface condition
General: Conform to the following:
- Wet pavement: Do not carry out spraying on a wet pavement, if rain appears imminent or during strong winds or dust storms.
- Surfaces for priming: Surface dry, and no more than damp to the depth of pavement penetration.
- Surfaces for primersealing: Damp, but not wet. If necessary, the pavement surface may be lightly watered shortly before applying the primerbinder.
- Surfaces for sealing: Dry and clean.

Environmental Risk
Risk assessment: The risk of environmental damage due to primer or primerbinder being washed off into adjacent drains and open watercourses as a result of rain on uncured materials must be considered as an element of an overall risk management plan. A guide to the risk of primer or primerbinder wash-off as a result of rain within stipulated periods after spraying is shown in Table A2.

Table A2 Priming Primersealing Risk Assessment
(From: Guide for Environmental Management when Spraying Bituminous Materials, AAPA HS&E Guide No 6)

<table>
<thead>
<tr>
<th>Weather conditions (Note 2)</th>
<th>Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–12 hours</td>
</tr>
<tr>
<td>Fine, sunny, warm/hot</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
### (a) Cutback bitumen

<table>
<thead>
<tr>
<th>Weather conditions (Note 2)</th>
<th>Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–12 hours</td>
</tr>
<tr>
<td>Fine, overcast, cool/warm</td>
<td>High</td>
</tr>
<tr>
<td>Damp, overcast, warm</td>
<td>High</td>
</tr>
<tr>
<td>Damp, overcast, cool</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Wet, overcast, warm</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Wet, overcast, cool</td>
<td>Unacceptable</td>
</tr>
</tbody>
</table>

### (b) Bitumen emulsions

<table>
<thead>
<tr>
<th>Weather conditions (Note 2)</th>
<th>Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–12 hours</td>
</tr>
<tr>
<td>Fine, sunny, warm/hot</td>
<td>Moderate</td>
</tr>
<tr>
<td>Fine, overcast, cool/warm</td>
<td>Moderate</td>
</tr>
<tr>
<td>Damp, overcast, warm</td>
<td>High</td>
</tr>
<tr>
<td>Damp, overcast, cool</td>
<td>High</td>
</tr>
<tr>
<td>Wet, overcast, warm</td>
<td>Unacceptable</td>
</tr>
<tr>
<td>Wet, overcast, cool</td>
<td>Unacceptable</td>
</tr>
</tbody>
</table>

1. The risk levels reflect the likelihood of a wash-off from granular pavements on moderate grades with typical crossfall. For roads on steep grades, or with abnormal crossfall, or with low porosity base course, the risk of wash-off is higher than that shown.
2. Typical temperatures associated with different weather conditions are: Hot = 25°C, Warm = 15–25°C, Cool = 15°C.
3. If risk is classified as unacceptable, application should be delayed until conditions improve.
4. If risk is classified as high, application should be delayed or the application and curing supervised continuously until dry. Precautionary measures include blocking of stormwater entry points, placing of spill response equipment, regular weather checks and frequent inspections.
5. If risk is classified as moderate, inspections must be frequent enough to respond to rain events. Stormwater entry points should be blocked and spill response equipment available on site.
6. If risk is classified as low, inspections may be less frequent but weather should be monitored to ensure prompt response to rain events.

### 7.4 PREPARATION OF AGGREGATES

#### Precoating of aggregate

Aggregate: Conform to either of the following:
- Precoated at the quarry, or on site, and stockpiled for later use, or
- Precoated on site, immediately prior to use.

Advance precoating is preferred to be done with a bitumen-based material that leaves a thin film of bitumen adhering to the aggregate. Bitumen based materials may be a mixture of bitumen, flux oil/cutter oil and adhesion agent or bitumen emulsion specifically formulated for use as aggregate precoating material. Bitumen/flux oil mixtures to be cured for a minimum of one week before use. Precoated aggregates that have been stockpiled for more than one month to be re-assessed for effectiveness of precoating and possible rejuvenation before use.

Precoating on site, for immediate use, to be done with either bitumen/flux oil mixture, flux oil, flux oil/cutter oil mixture, cutter oil or bitumen emulsion specifically formulated for use as aggregate precoating material. Adhesion agent to be added to oil based precoating materials at the rate of 1% by volume when aggregates are damp or the weather conditions are unfavourable with rain threatening or humid conditions.
Apply the aggregate precoating agent to the aggregate in a manner and at a rate and time which will provide a complete, light, uniform, effective cover of all aggregate particles at the time of spreading.

A guide to rates of application on clean, dry aggregates is given in Table A3. Dusty or dirty aggregates require a heavier rate of precoating than clean dry aggregates of the same type and size. For porous aggregates, rates may need to be increased by up to 2 L/m³, and for smooth, hard aggregates, reduced by up to 2 L/m³, from the values shown in Table A3. Generally, bitumen based materials and emulsions require higher rates of application than oil based precoating materials.

Field precoating of aggregate for immediate use is not to be carried out when rain is imminent. If aggregate has been precoated and rain appears imminent, adequately cover the aggregate to prevent the fresh precoating material being washed from the aggregate particles.

Take precautions, such as covering stockpiles, to prevent settlement of dust, penetration of moisture or drying out of the precoating material on the stockpiled aggregate.

**Table A3 Typical precoating rates (L/m³)**

<table>
<thead>
<tr>
<th>Aggregate condition</th>
<th>Precoating material</th>
<th>Bitumen based, including bitumen emulsions</th>
<th>Oil based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>6 to 12</td>
<td>4 to 10</td>
<td></td>
</tr>
<tr>
<td>Dirty</td>
<td>8 to 14</td>
<td>6 to 12</td>
<td></td>
</tr>
</tbody>
</table>

7.5 PREPARATION OF BITUMEN BINDER

Proportion of cutter oil

Determine and record the proportion of cutter oil required for each sprayer load. Tables A4 and A5 provide a guide to the proportions of cutter oil for Class 170 or 320 bitumen, multigrade binder and polymer modified binders, respectively.

Adding cutter oil: Binder to be within the temperature range shown in Table A6 when cutter oil is incorporated. The sprayer load of cutback bitumen to be circulated at a rate of at least 700 litres/min (approximately 350 rpm) for a minimum of twenty minutes before spraying.

Take care to ensure that any material that is to be added to hot binder is free of moisture. Materials considered at risk from moisture contamination, for example drummed materials stored in the open, should be checked with a water-finding paste before use. When adding cutter oil to standard bitumen binders, risks associated with moisture can be reduced by placing the cutter oil into a sprayer that has not been previously heated, followed by the hot bitumen.

When adding cutter oil to polymer modified bitumen binders, including crumb rubber binder, the cutter oil is to be added to the hot binder.

If a part sprayer load of field prepared cutback bitumen is unused on the day of mixing, and needs to be returned to the heater tanks, place it in a tank reserved for that purpose. No bitumen or cutter oil to be added to the returned cutback bitumen unless the tank is fitted with an effective circulation system. When the returned cutback bitumen is subsequently used as part of a sprayer load, make allowance for the cutter oil contained in the returned cutback bitumen.

Cutback bitumen to be within the temperature range shown in Table A7 at the time of spraying. Spraying temperatures for proportions of cutter oil between those shown in the table may be established by interpolation.

Adding flux oil

If flux oil is to be included, it is to be added to the bitumen in the sprayer and the mixture circulated at a rate of at least 700 litres/min for 20 minutes before spraying. Take care to ensure that flux oil that is to be added to hot binder is free of moisture.

Adding bitumen adhesion agent

If bitumen adhesion agent is to be included, add it to the bitumen in the sprayer and the entire mixture circulated at a rate of at least 700 litres/min for 20 minutes, after addition of the last component, before spraying.

If bitumen containing adhesion agent is not used within 8 hours of mixing with hot bitumen, the active contribution of adhesion agent is to be ignored in subsequent use of the bitumen material. However, make allowance for the oil component of the adhesion agent in the returned bitumen.
### Table A4 Basic Cutting Practice for Class 170 Bitumen and Multigrade Binder
(Parts by volume of cutter oil to be added to bitumen measured at 15°C).

<table>
<thead>
<tr>
<th>Aggregates of 10 mm nominal size or larger</th>
<th>Aggregates of 7 mm nominal size or smaller</th>
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<tr>
<td>Pavement temperature (°C)</td>
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<td>&gt;45</td>
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1. Rates are based on fine, stable weather conditions and active, freshly applied or partially dried oil or bitumen precoating.
2. For dry or inactive precoating, add 2 parts except for heavy traffic and high pavement temperatures.
3. For damp aggregates, add 2 parts, except for heavy traffic and high pavement temperatures.
4. For periods of falling temperatures, add 2 parts or up to 4 parts if very cold overnight temperatures are expected to follow.
5. Add a further 2 parts of cutter oil for pavement temperatures below 15°C, provided that sprayed sealing work should not be carried out at temperatures below 10°C.
7. In double/double seals, where the second application is to be applied the same day, or without any significant period of trafficking, it is undesirable to include any cutter oil in the first binder application. If cutter oil is considered necessary, it should be a maximum of 2 parts.
8. If cutter proportions are added as a percentage of total binder, the proportions shown here as parts per 100 parts of bitumen may be taken as a reasonable approximation of percentage by volume.
9. If pavements are not intended to carry normal design traffic for a period of time after sealing, the proportion of cutter oil may be varied to reflect the conditions likely to prevail at the time of opening to traffic.

### Table A5 Guide to Cutting Practice for PMBs used in SAM and HSS Applications 1, 2
(Parts by volume of cutter oil to be added to 100 parts by volume of PMB-measured at 15°C) (Note 3)

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<th>Pavement Temperature (°C)</th>
<th>Traffic (veh/lane/day)</th>
<th>Class of PMB</th>
<th>S15E</th>
<th>S20E</th>
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<td>26 to 32</td>
<td>&lt;1000</td>
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1. In SAMI applications, if the seal is to be covered by asphalt within a short period, it is undesirable to include any cutter oil at all. If cutter oil is considered necessary, it should be a maximum of 2 parts of cutter oil to 100 parts of PMB. Similar provisions apply to the first binder application of a double/double seal if the second application is to follow the same day, or within a short period.
2. In aggregate retention applications using lower levels of polymer modification i.e. S10E, and some proprietary blends of PBD, the binder should be cut back as per normal Class 170 bitumen.

3. If cutter proportions are added as percentage of total binder, the proportions shown here as parts per 100 parts of PMB may be taken as a reasonable approximation of percentage by volume.

4. Pavement temperature should generally be based on the worst condition, i.e., shaded areas.

5. Pre-blended crumb rubber grades may contain process oil used in their manufacture. This oil will most likely reduce the viscosity compared to field blended grades, and may allow a small reduction, say 2 parts, in added cutter oil compared to field produced grades.

6. At high rates of application of binder (greater than say 2 L/m²) the proportion of cutter oil may be reduced by 2 parts.

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<table>
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<th>Table A7 Cutback Bitumen Spraying Temperature</th>
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7.6 APPLICATION OF PRIMER, PRIMERBINDER AND BINDER

General
The area to be sprayed with primerbinder or binder is to be limited to the area that can be covered with aggregate within fifteen minutes of spraying.

Primer and primerbinder
The class and grade of primer and primerbinder to be as specified in Schedule of job details.

Application rates and quantities of primer and primerbinder applied to the mixture, including cutter oil or the water content of bitumen emulsion, are measured at 15°C.

After application of a primer, a period of at least seventy-two hours, or such longer period as determined to be necessary for the primer to become completely dry, is to elapse before the binder for a seal is applied. All traffic to be kept off the primed surface.

If it is necessary to give traffic limited access to the primed surface, the surface is to have a light layer of grit applied to avoid pickup. Gritting is not to be applied until a substantial proportion of the primer has been absorbed into the pavement.

Binder
The class or type of bitumen, modified bitumen, cutback bitumen, or bitumen emulsion is to be as specified in the Schedule of job details.
Nominated and target application rates and quantities of binder to be based on the volumes of bitumen measured at a temperature of 15°C and not include any adhesion agent and/or cutter oil or the water content of emulsions. If flux oil has been added to the bitumen, the quantity of flux oil is to be included as part of the binder.

If adhesion agent and/or cutter oil have been added to the binder, adjust the application rate of the total binder at 15°C to allow for the quantities of adhesion agent and/or cutter oil in the mixture.

Determine the forward speed of the bitumen sprayer based on either:
- the hot application rate of total binder, including adhesion agent and/or cutter oil, or
- allowances for temperature and proportion of adhesion agent and cutter oil, measured at 15°C.

Volume correction factors for converting volume of bituminous binders from 15°C to elevated temperature, or from elevated temperature back to 15°C are shown in Tables A8 and A9.

### Table A8 Volume Conversion Table – Bitumen (Including cutback bitumen)

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Table A9 Volume Conversion Table – Bitumen Emulsion

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COLD LITRES x B = HOT LITRES (T°C)

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7.7 APPLICATION OF SPRAYED BITUMINOUS SURFACING

Plant
Use a mechanical sprayer to apply primer, primerbinder and binder. The sprayer is to have a current Sprayer Certificate issued by a NATA accredited testing authority. Keep a copy of the test certificate with the sprayer.

A register of accredited sprayers is maintained by AAPA and available on the AAPA Web Site (www.aapa.asn.au).

The spray nozzles are to be of the make and type endorsed on the Sprayer Certificate. Any nozzles that may be damaged or become unduly worn or defective are to be replaced.

Use mechanical spreading equipment to spread aggregate which is capable of achieving a uniform spread rate.

Rollers to be pneumatic tyred multi-wheel rollers with a minimum mass of 7 tonnes, smooth tyres and a minimum tyre pressure of 550 kPa, or combination rollers having a rubber coated, vibratory drum on one axle and pneumatic tyres on the other. Rollers must be capable of achieving effective incorporation of aggregate into the binder without breakdown or crushing of the cover aggregate.

Remove from the work any plant or equipment not fully operational or not in a satisfactory condition for carrying out work in conformance with this worksection.

Operation of the sprayer
The type of spray nozzles to be used on the spray bar of the sprayer is to be compatible with the nature of the binder to be sprayed and its application rate.

Where the longitudinal edges of spray runs are not required to overlap, either special type end nozzles or intermediate nozzles set with a jig as end nozzles may be used. Where an overlap is required, the overlap of spray between adjacent longitudinal runs to be 50 mm for special type end nozzles or jig set intermediate nozzles. If intermediate nozzles, set in the normal manner, are to be used to overlap adjacent longitudinal sprays, the overlap is to be 300 mm.

The spraying of primer, primerbinder or binder for each run of the sprayer is to commence on a protective strip of heavy paper laid across, and held securely to, the pavement surface beforehand. The sprayer is to commence moving at a sufficient distance in advance of the protective strip to ensure that the road speed for correct application is attained at the commencement of spraying.

The sprayer to maintain a constant road speed throughout the length of each sprayer run.

The spraying for each run to terminate on protective paper laid across, and held securely to, the pavement surface beforehand.

Cease spraying immediately any defect develops in the spraying equipment and the fault rectified before further spraying.

If any blockage or partial blockage of nozzles occurs, cease spraying immediately. Spraying is not to recommence until the cause of the blockage is identified and rectified.
Areas not within 5% of the target application rate of primer, primerbinder or binder shall constitute a 'non-conformance' under the contract.

If a mechanical sprayer is not able to satisfactorily spray small areas or areas of irregular shape, spray such areas by means of the hand spray equipment attached to the sprayer.

After each sprayer run, check the quantity of binder sprayed against the area covered. If the actual application rate is not within specified limits, make adjustments to ensure that the target application rate is achieved in subsequent runs.

**Temperature**

Measure and record the temperature of the binder.

If the temperature of the bituminous material is below the applicable lower limit from Tables A6 or A7, the bituminous material may be heated provided that safe heating practices are adopted. All heating activities to conform to the Austroads AP-G41 *Bitumen Sealing Safety Guide*.

Do not use burners unless the level of the material in the heating tank is at least 150 mm above the tops of the heating tubes, or as indicated by the manufacturer of the equipment. Two or more suitable fully charged pressurised chemical fire extinguishers to be placed conveniently to the heaters at all times while heating is in progress.

During heating, the temperature of the bituminous material not to exceed the applicable upper limit from Tables A6 or A7. The rate of heating is not to exceed the rate shown in Table A10. Materials to be circulated at all times while heating and for a further minimum of 15 minutes after burners are turned off.

**Table A10: Maximum Heating Rate for Bituminous Materials**

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum Heating Rate (°C/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitumen &amp; Multigrade binder</td>
<td>40</td>
</tr>
<tr>
<td>Cutback Bitumen:</td>
<td></td>
</tr>
<tr>
<td>- Priming grades</td>
<td>30</td>
</tr>
<tr>
<td>- Primersealing grades</td>
<td>30</td>
</tr>
<tr>
<td>- Sealing grades</td>
<td>30</td>
</tr>
<tr>
<td>Crumb rubber bitumen</td>
<td>40</td>
</tr>
<tr>
<td>Polymer modified binder</td>
<td>Refer manufacturer’s recommendations</td>
</tr>
<tr>
<td>Bitumen emulsion</td>
<td>15</td>
</tr>
</tbody>
</table>

**Geotextile**

Apply geotextile if nominated in the *Schedule of details*. Fix the geotextile to the pavement smoothly and without wrinkles, using a tack coat of up to 0.8 L/m² (residual) of Class 170 bitumen. The rate of application of tack coat is included in, and not additional to, the overall design binder application rate for the geotextile reinforced seal (including allowances for surface texture and absorption by the fabric).

Joins to be butt joined or overlapped by a minimum of 200 mm as specified in the *Schedule of details*. Longitudinal joins not to be placed in wheel paths.

**Work records**

Record details of the work performed. Details of primer, primerbinder, binder and aggregate applied to be recorded immediately after every sprayer run. Each form is to be signed by the Contractor’s representative as a true record of the work performed. Supply to the Superintendent a copy of each completed form.

**Control of traffic**

Provide for traffic in conformance with the requirements of AS 1742.3 while undertaking the work and take all necessary precautions to protect the work from damage until such time as the new seal coat has developed sufficient strength to carry normal traffic without disturbance of the aggregate. Where early use of the new seal is needed to facilitate the movement of traffic, vehicles may be allowed to run on the work after initial rolling has taken place provided that vehicles are controlled to such slow speeds that no displacement of aggregate occurs. Where necessary, use patrol vehicles to ensure that traffic travels at an acceptable speed.
Take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or sidetracks are included in the Contract or are otherwise available, direct traffic temporarily while the work is in progress.

If facilities for the diversion of traffic are not available, spray part width of the pavement in the one operation and make available to traffic the adjacent strip of roadway or schedule spraying operations in such a manner so as to restrict traffic delays to a maximum of 15 minutes. All traffic movement through the work are to cease during the actual spraying operation.

Detailed records of traffic control including control device type, precise location of device and the time at which such device was installed and removed, to be maintained throughout the works and then kept on file.

7.8 SPREADING AND ROLLING OF AGGREGATE

Proceed with spreading of aggregate as soon as practical after spraying of the binder has commenced and complete within fifteen minutes of spraying.

Apply the aggregate of the specified nominal size and at the target aggregate application rate. The method to determine the actual aggregate spread rate is to be detailed in the Quality Plan. Ensure that sufficient loaded and measured trucks of aggregate are at the site to provide full cover for the area sprayed.

Spread the aggregate uniformly over the sprayed surface by means of suitable mechanical spreading equipment.

Calibrate spreaders with aggregate from the stockpile to be used for the work. Calibration is best done off-road. A calibration site needs to be of sufficient length to allow the aggregate spreading unit to reach normal operational speed before applying the aggregate. Calibration can be done with standard calibration mats or by painting 1 m² areas on the test site. The total width of the aggregate spreader must be calibrated.

Any bare or insufficiently covered areas to be re-run by the mechanical spreader or covered by hand as necessary to give a uniform and complete coverage. Remove any local excess of aggregate before rolling is commenced.

Supply sufficient rollers to ensure that total area sprayed receives the minimum coverage (roller hours) derived from Table A11. Allow adequate time at the end of the day's work to ensure that the last materials spread receive the same amount of rolling as that placed earlier in the day.

After the aggregate has been applied to each section of the work, carry out initial rolling with one or more rollers complying with Application of primer, primerbinder and binder.

Continue initial rolling until the aggregate is firmly adhered to the primerbinder or binder.

Reduce the amount of rolling while the aggregate is wet, but resume normal rolling as soon as aggregate dries. Trafficking during this period to be avoided, or kept to a minimum speed, until aggregate has dried sufficiently for adhesion to be established.

Table A11 Area that can be effectively rolled, per hour, with each pneumatic tyre multi-wheel roller

<table>
<thead>
<tr>
<th>Aggregate size (mm)</th>
<th>Traffic Volume (vehicles per lane per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 300</td>
</tr>
<tr>
<td></td>
<td>300–1200</td>
</tr>
<tr>
<td></td>
<td>&gt; 1200</td>
</tr>
<tr>
<td></td>
<td>Area – m² per roller hour</td>
</tr>
<tr>
<td>7 or smaller</td>
<td>4500–5000</td>
</tr>
<tr>
<td>10</td>
<td>5000–5500</td>
</tr>
<tr>
<td></td>
<td>5500–6000</td>
</tr>
<tr>
<td>14</td>
<td>3000–3500</td>
</tr>
<tr>
<td></td>
<td>3500–4000</td>
</tr>
<tr>
<td></td>
<td>4500–5000</td>
</tr>
<tr>
<td></td>
<td>4500–5000</td>
</tr>
<tr>
<td></td>
<td>3000–3500</td>
</tr>
<tr>
<td></td>
<td>3500–4000</td>
</tr>
</tbody>
</table>

If the aggregate is not evenly distributed over the surface of the pavement, traverse the surface with a light drag broom after the initial rolling. If the broom has any tendency to dislodge aggregate particles bedded in the primer binder or binder, defer or eliminate the drag brooming. Where drag brooming is eliminated, the Contractor may substitute light hand brooming.

Then carry out back rolling until the effective amount of rolling in terms of roller hours for the total area sprayed achieves that shown in Table A11.

When the aggregate has been evenly distributed and adhered to the binder, remove any remaining loose particles of aggregate from the pavement.

Variations to spreading and rolling procedures are to be applied to different types of seals as follows:
- Single/single seals A single application of aggregate is to be applied on a single application of binder and then the seal is rolled and, where necessary, brooming carried out as described above.

- Single/double seals In a single/double seal, the second application of aggregate is applied after initial rolling of the first application, and before final rolling and trafficking.

- Double/double seals Where both applications of binder and aggregate are to be applied on the same day, the first application of binder and aggregate to be completed as described above, except that the aggregate application is reduced by approximately 10% compared to that required for a single/single seal. The second application of aggregate, following the second application of binder, is to be applied at a rate that is just sufficient to fill the voids in the first application, and rolling and removal of any remaining loose aggregate completed as described above. Where the binder in the first application is a bitumen emulsion, the second application must not be applied until the binder in the first coat is completely broken to form a stable seal.

Where the first application of a double/double seal is to be trafficked for a short period of time, generally not exceeding several weeks, the first application is to be completed as a single/single seal and the aggregate in the second application reduced by about 30% to occupy the voids in the first application.

Where the second application is applied after a significant period of trafficking, both applications are to be completed as single/single seals.

8 RESERVED
1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide various categories of hot mixed asphalt for roads and related applications, as documented, comprising:

- Asphalt materials.
- Asphalt mix design requirements.
- Process control in manufacture and placement of asphalt.
- Acceptance criteria for asphalt.
- Quality systems, minimum process standards, plant requirements and sampling and testing frequencies.

Design
Designer: Design the asphalt mixes. RPEng/CPEng/ Roads and Maritime Services (RMS) Certified or AAPA accredited with 5 years experience or RMS accredited designs.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):

- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:

Note: Only the most current standards are to be used

AS 1141 Methods for sampling and testing aggregates
AS 1141.17 Voids in dry compacted filler
AS 1141.25.3 Degradation factor - Fine aggregate
AS 1160 Bituminous emulsions for the construction and maintenance of pavements
AS 1672 Limes and Limestones
AS 1672.1 Limes for Building
AS 2008 Residual bitumen for pavements
AS 2124 General conditions of contract
AS 2150 Hot mix asphalt - a guide to good practice
AS 2758 Aggregates and rock for engineering purposes
AS 2758.5 Coarse asphalt aggregates
AS 3582 Supplementary cementitious materials for use with portland cement,
AS 3582.1 Fly Ash
AS 3582.2 Slag – Ground Granulated Iron Blast-Furnace.
AS 3940 Quality control - Guide to the use of control chart methods including Cusum techniques
AS 3942 Quality control - Variables charts - Guide
AS 3972 General purpose and Blended Cements
AS/NZS/ISO 9001 Quality Management Systems – Requirements

Other publications
Note: Only the most current standards are to be used

RMS

NSW RMS Test Methods
QA Specification 3253Bitumen for pavements.
AAPA
AAPA Advisory note 7 Guide to the selection, heating and storage of binders for sprayed sealing and hot mixed asphalt.
AAPA IG-3 Asphalt plant process control guide (Implementation Guide series)
AUSTROADS
AP-T41 Specification framework for polymer modified binders and multigrade bitumens
AGPT02 Guide to Pavement Technology Part 2 – Pavement structural design.
AGPT03 Guide to Pavement Technology Part 3 – Pavement surfacings
AGPT04B Guide to Pavement Technology Part 4B - Asphalt
AGPT04E Guide to Pavement Technology Part 4E – Recycled materials
AGPT04F Guide to Pavement Technology Part 4F - Bituminous binders
AGPT04J Guide to Pavement Technology Part 4J - Aggregate and source rock
AGPT04K Guide to Pavement Technology Part 4K - Seals

1.4 STANDARDS

General
Standards: To AAPA National asphalt specification, AGPT02, AGPT03 and AGPT04B.

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the abbreviations given below apply.
- AC: Asphaltic concrete.
- FGGA: Fine gap graded asphalt.
- RAP: Reclaimed asphalt pavement.

Definitions
General: For the purposes of this worksection the definitions given below apply:
Asphalt mixes: Dense graded asphalt mixes have been classified:
- In terms of position in the pavement (wearing course or base course) and
The particular mixes to be used to be nominated in the as detailed in the approved CC drawings.
Dense graded hot mix asphalt is also known as asphaltic concrete and designated by the abbreviation 'AC'.
RMS- Roads and Maritime Services.

1.6 SUBMISSIONS

Planning requirements
Testing: Conform to the following:
- Testing: All testing of properties required by the worksection is to be undertaken in a laboratory registered by the National Association of Testing Authorities (NATA) for the appropriate tests and performed in accordance with procedures contained in the relevant Australian Standard or Austroads Manual of Test Procedures.
- Where there is no applicable Australian Standard or Austroads Test Method, or where the Standard or Manual provides a choice of procedures, adopt the method endorsed by the relevant State Road Authority in the State in which the work is being undertaken.

Register and Insure Plant: Conform to the following:
- Register and insure all plant as appropriate to its use on a public road. Plant to comply with statutory environmental regulations. This is a HOLD POINT.
- Provide all the plant and equipment and labour necessary for carrying out the work in accordance with this worksection.
- All plant and equipment used on the work is to be suitable and in accordance with the Contractor's submitted quality documentation and kept in good operating condition.
- Do not use in the work any plant or equipment demonstrated to be faulty in operation so as to effect the product quality or unsafe in operation as assessed by the Superintendent. This is a WITNESS POINT.

Control of Traffic: Conform to the following:
- Provision for traffic: Provide for traffic in accordance with 1101 Control of traffic while undertaking the work.
- Take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work but without compromise to the safety of the employees and the road users.

Approvals
General: Comply with Superintendent approval.

Components
General: Refer to Materials.

Design
All asphalt mixes: Refer to Mix Design.

Drawings
General: Prepare drawings or other document.

Execution details
General: Conform to worksection requirements.

Materials
General: Refer listed materials for submissions.

Type tests
General: Submit previously designed mix. Refer Approval of Job Mix.

Warranties
General: As required by the Conditions of Development Consent.

1.7 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submissions – Planning requirements</td>
<td>Evidence that plant is registered and insured</td>
<td>2 weeks before using plant</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Selection of criteria for coarse aggregate hardness and durability</td>
<td>7 days before proceeding with selection</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Source</td>
<td>Submit evidence of quality and effect of material on the properties of the asphalt mix</td>
<td>7 days before proceeding with mix</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Mineral filler</td>
<td>Submit evidence of quality and effect of material on the properties of the asphalt mix</td>
<td>7 days before proceeding with mix</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Mix design</td>
<td>Submit mix design for Superintendent approval</td>
<td>14 days before using mix</td>
<td>Superintendent</td>
</tr>
<tr>
<td>General</td>
<td>Mixes containing more than 30% RAP to be submitted for assessment and can only be used in the base course, not in wearing course.</td>
<td>7 days before using mix</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Approval of Job Mix - General</td>
<td>Provide information in formatting specified to</td>
<td>7 days before using mix</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Clause/subclause</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td>Release by</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------</td>
<td>-----------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Approval of Job Mix - Approval to use previously designed mix</td>
<td>Details of previously designed mix to be submitted</td>
<td>7 days before commencing production</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Sampling and testing</td>
<td>Frequency varied to correct non-conformance</td>
<td>24 hours after non-conformance identified</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Non complying materials – Non compliance</td>
<td>Assessment of valuation or remedial procedure</td>
<td>24 hours after non-conformance</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Delivery – work records</td>
<td>Submission for counter signing</td>
<td>Each day for daily completion</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Placing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spreading</td>
<td>Procedure proposed for low temperature spreading</td>
<td>24 hours before proposed spreading</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Joints</td>
<td>Submit plan of joints location for approval</td>
<td>7 days before commencing</td>
<td>Superintendent</td>
</tr>
<tr>
<td>WITNESS POINTS table</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clause/subclause</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td></td>
</tr>
<tr>
<td>Submissions – Planning requirements</td>
<td>Superintendent to assess faulty plant</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Aggregate – General</td>
<td>Source subject to inspection and approval of Superintendent</td>
<td>3 weeks before importing aggregate</td>
<td></td>
</tr>
<tr>
<td>Mix design – Approval of Job Mix</td>
<td>Submission of samples of constituent materials</td>
<td>7 days before importing materials</td>
<td></td>
</tr>
<tr>
<td>Manufacture and storage – Storage of mixed asphalt</td>
<td>Inspection of storage procedures by Superintendent</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Placing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection of services and road fixtures</td>
<td>Inspection of condition of road fixtures and fixtures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tack coating</td>
<td>Direction by Superintendent to omit tack coat</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Finished pavement properties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>Provide notice of procedures and results to Superintendent</td>
<td>Progressive</td>
<td></td>
</tr>
</tbody>
</table>

2 MATERIALS

2.1 AGGREGATE

General
Standard: To AGPT04J.

Source: Obtain all materials from established sources and have established properties. Obtain each individual component of coarse and fine aggregate from the same sources as materials in design of the Job Mix.

Separate stockpiles of all aggregates from different sources or of different sizes.
Where requested, the source of all materials is subject to inspection and approval by the Superintendent and only material from a nominated quarry face or location is to be used. This is a WITNESS POINT.

Coarse aggregate
General: Conform to the following:
- Coarse aggregate is comprised of particles that are retained on the 4.75 mm sieve.
- Coarse aggregate to comply with AS 2758.5 with the application of those test properties specified in Tables 2.1, 2.2 and 2.3 as appropriate except that the Superintendent may approve the use of non-complying materials from sources of proven performance. This is a HOLD POINT.

Tables 2.1 and 2.2 provide alternative combinations of hardness and durability and use only one combination. Select the particular hardness and durability combination to be used unless specified in the Schedule of Job Details.

Fine aggregate
Fine aggregate: Conform to the following:
- Fine aggregate consists of crushed rock particles finer than the 4.75 mm sieve and manufactured from an approved source complying with the requirements of Coarse aggregate, clean natural sand, or both.
- The fine aggregate is to be clean, hard, durable and free from lumps of clay and other aggregations of fine materials, organic material and any other deleterious material.
- Fine aggregate consisting of crushed rock particles to have a minimum Degradation Factor, Crusher Fines of 60 when tested in accordance with AS 1141.25.3.

Table 2.1 Coarse Aggregate Requirements for Hardness and Durability Based on Los Angeles Abrasion Loss and Unsound and Marginal Stone Content

<table>
<thead>
<tr>
<th>Test property</th>
<th>Test value</th>
<th>Other Mix types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Abrasion Loss (% maximum)</td>
<td>Rock type</td>
<td>LA</td>
</tr>
<tr>
<td>All</td>
<td>25</td>
<td>Acid Igneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Granite rocks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Others</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intermediate igneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic igneous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Metamorphic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sedimentary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dense metallurgical slags</td>
</tr>
<tr>
<td>Unsound stone content (%)</td>
<td>3 maximum</td>
<td>5 maximum</td>
</tr>
<tr>
<td>Marginal and unsound stone content (%)</td>
<td>8 maximum</td>
<td>10 maximum</td>
</tr>
</tbody>
</table>

Table 2.2 Coarse Aggregate Requirements for Hardness and Durability Based on Wet Strength and Wet/Dry Strength Variation

<table>
<thead>
<tr>
<th>Test property</th>
<th>Test value</th>
<th>Other Mix types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten Percent Fines Value (Wet) (kN)</td>
<td>150 minimum</td>
<td>100 minimum</td>
</tr>
<tr>
<td>Wet/Dry Strength Variation (%)</td>
<td>35 maximum</td>
<td>35 maximum</td>
</tr>
</tbody>
</table>

Table 2.3 Other Coarse Aggregate Requirements

<table>
<thead>
<tr>
<th>Test property</th>
<th>Test value</th>
<th>Other Mix types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flakiness Index (% maximum)</td>
<td>25</td>
<td>35</td>
</tr>
</tbody>
</table>
Mineral filler

Definition: Mineral filler is that portion of mineral matter passing a 75 micron sieve, and includes rock dust derived from coarse and fine aggregates used in the production of asphalt in conformance with this worksection, and any other materials added to supplement the quantity and properties of filler in the mix.

Mineral filler: Conform to the following:
- The total filler component in the combined job mix for medium, heavy and very heavy traffic mix types to have a value of dry compacted voids in accordance with AS 1141.17 not less than 38%.
- Filler to be consistent in mineral composition and dry compacted air voids, to be dry, and free from lumps, clay, organic matter or other material deleterious to asphalt.
- Added filler (material not derived from the aggregate components) to comply with the relevant standards listed in Table 2.4. The Superintendent may approve materials other than those listed in Table 2.4 provided that the Contractor supplies evidence of the quality and effect of the proposed materials on the properties of the asphalt mix.

This constitutes a HOLD POINT.

Rock dust that is not derived from the other aggregate components in the mixture may also be used as added filler provided that it is derived from materials that meet the requirements of Aggregate. Materials for use as added filler are to meet the test requirements specified in Table 2.6.

Table 2.4 Standards for Materials Used as Added Filler

<table>
<thead>
<tr>
<th>Material</th>
<th>Standard (See Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrated lime</td>
<td>AS 1672.1 Limes and Limestone – Lime for Building</td>
</tr>
<tr>
<td>Fly Ash</td>
<td>AS 3582.1 Fly Ash Table 1, Fine Grade.</td>
</tr>
<tr>
<td>Cement Kiln Dust</td>
<td>See note 2</td>
</tr>
<tr>
<td>Slag</td>
<td>AS 3582.2 Slag – Ground Granulated Iron Blast-Furnace</td>
</tr>
<tr>
<td>Ground Limestone</td>
<td>See note 3</td>
</tr>
<tr>
<td>Cement</td>
<td>AS 3972 General purpose and Blended cements</td>
</tr>
</tbody>
</table>

1. Provision of test certificates for compliance with the relevant Australian Standard and this specification to be limited to those tests listed in Table 2.6.
2. Cement kiln dust to be solid material extracted from the flue gases in the manufacture of Portland cement, having a maximum water soluble fraction of 20% by mass and complying with the grading limits specified in Table 2.5.
3. Ground limestone to consist of rock dust derived from the grinding of sound limestone and complying with the grading limits specified in Table 2.5.

Table 2.5 Grading Limits for Ground Limestone and Cement Kiln Dust Materials for Use as Added Filler

<table>
<thead>
<tr>
<th>Sieve Size AS (mm)</th>
<th>Percentage passing sieve size (by mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.600</td>
<td>100</td>
</tr>
<tr>
<td>0.300</td>
<td>95-100</td>
</tr>
<tr>
<td>0.075</td>
<td>75-100</td>
</tr>
</tbody>
</table>

Table 2.6 Test Requirements for Materials for Use as Added Filler

<table>
<thead>
<tr>
<th>Filler type</th>
<th>Test type</th>
<th>Test requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filler type</td>
<td>Test type</td>
<td>Test requirements</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>All</td>
<td>Grading (AS 0.600 mm, 0.300 mm and 0.075 mm sieves)</td>
<td>Report</td>
</tr>
<tr>
<td>All</td>
<td>Voids dry compacted filler</td>
<td>Report</td>
</tr>
<tr>
<td>All</td>
<td>Moisture content</td>
<td>3% max.</td>
</tr>
<tr>
<td>Fly ash</td>
<td>Loss on ignition</td>
<td>4% max.</td>
</tr>
<tr>
<td>Cement kiln dust</td>
<td>Water soluble fraction</td>
<td>20% max.</td>
</tr>
</tbody>
</table>

2.2 BINDER

Bitumen
Bituminous binders: To AGPT04F.
Class AR450 bitumen: Conform to RMS QA Specification 3253.
Multigrade bitumen: Conform to Austroads AP-T41 Specification framework for polymer modified binders and multigrade bitumens.

Other binders
Polymer modified binder: Comply with the Austroads AP-T41 Specification framework for polymer modified binders and multigrade bitumens.

Additives
Type and proportion: The type and proportion of additives to be used in the mix, other than those specified elsewhere in this worksection, to be in conformity with an approved specification which may be a manufacturer’s recommendation, purchaser’s specification or as agreed between the parties.

Warm mix asphalt additive
General: If required, include warm mix asphalt additive to asphalt to reduce the asphalt manufacturing temperature and/or to improve workability during the paving and compaction operations.

Rejuvenating agent
Properties: Rejuvenating agent, if required in mixes incorporating recycled asphalt, to be a low volatility oil capable of combining with bitumen to counteract hardening and produce a lower viscosity grade of binder. Rejuvenating agent to comply with recognised standards for such materials.

2.3 RECLAIMED ASPHALT PAVEMENT

Requirements
General: Provide reclaimed asphalt pavement (RAP) from milling or excavation of existing asphalt in conformance with the following:
- Crushed and screened as necessary to ensure a maximum size no greater than the maximum size of asphalt being produced and to achieve a reasonably well graded, free flowing, and consistent product.
- Free of foreign material such as unbound granular base, broken concrete, crumbed rubber or other contaminants. Asphalt containing tar is not to be used.
- Place in separate stockpiles prior to use.

2.4 MIX DESIGN

General
Requirements: Provide all mix designs. Where specified, the Contractor’s mix design is to be assessed by the Superintendent for compliance with the requirements of this worksection. In such cases, the mix design is to be approved by the Superintendent prior to its use.
This is a HOLD POINT.
The types of mixes to be as listed in the schedule of job requirements, or as shown on drawings.

Aggregate grading and binder content
General: Unless otherwise specified, design asphalt mixes with a target combined aggregate grading (including filler) and binder content complying with the relevant limits given in Tables 2.7, 2.8, 2.9, 2.10 or 2.11. Bitumen content is expressed as a percentage by mass of the total mix.
### Table 2.7 Dense Graded Asphalt (Medium, Heavy and Very Heavy Traffic Heavy Wearing Course and all Base Course Mix Types)

<table>
<thead>
<tr>
<th>Sieve Size AS (mm)</th>
<th>Mix designation</th>
<th>AC10</th>
<th>AC14</th>
<th>AC20</th>
<th>AC28</th>
<th>AC40</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage passing sieve size (by mass)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.5</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>26.5</td>
<td>100</td>
<td>90–100</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
<td>90–100</td>
<td>72–87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2</td>
<td>90–100</td>
<td>71–86</td>
<td>58–76</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>90–100</td>
<td>72–83</td>
<td>58–75</td>
<td>47–67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.7</td>
<td>68–82</td>
<td>54–71</td>
<td>46–64</td>
<td>37–58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.75</td>
<td>50–70</td>
<td>43–61</td>
<td>37–55</td>
<td>30–50</td>
<td>27–43</td>
<td></td>
</tr>
<tr>
<td>2.36</td>
<td>32–51</td>
<td>28–45</td>
<td>24–42</td>
<td>20–37</td>
<td>16–33</td>
<td></td>
</tr>
<tr>
<td>1.18</td>
<td>22–40</td>
<td>19–35</td>
<td>15–32</td>
<td>13–28</td>
<td>11–26</td>
<td></td>
</tr>
<tr>
<td>0.600</td>
<td>15–30</td>
<td>13–27</td>
<td>10–24</td>
<td>9–22</td>
<td>7–20</td>
<td></td>
</tr>
<tr>
<td>0.300</td>
<td>10–22</td>
<td>9–20</td>
<td>7–17</td>
<td>6–16</td>
<td>5–14</td>
<td></td>
</tr>
<tr>
<td>0.150</td>
<td>6–14</td>
<td>6–13</td>
<td>4–12</td>
<td>4–10</td>
<td>4–10</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>4–7</td>
<td>4–7</td>
<td>3–6</td>
<td>3–6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binder Content (% by mass)</td>
<td>4.5–6.5</td>
<td>4.0–6.0</td>
<td>3.8–5.8</td>
<td>3.5–5.5</td>
<td>3.0–5.0</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: 1. For high fatigue base course mix types, the range of binder content shall be increased by 1 percentage point.

### Table 2.8 Dense Graded Asphalt (Light Traffic Wearing Course Mix Types)

<table>
<thead>
<tr>
<th>Sieve Size AS (mm)</th>
<th>Mix designation</th>
<th>AC7</th>
<th>AC10</th>
<th>AC14</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage passing sieve size (by mass)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2</td>
<td>100</td>
<td>90–100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>90–100</td>
<td>72–87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.7</td>
<td>85–100</td>
<td>68–87</td>
<td>54–79</td>
<td></td>
</tr>
<tr>
<td>4.75</td>
<td>70–87</td>
<td>50–76</td>
<td>43–69</td>
<td></td>
</tr>
<tr>
<td>2.36</td>
<td>44–65</td>
<td>32–57</td>
<td>28–53</td>
<td></td>
</tr>
<tr>
<td>1.18</td>
<td>29–48</td>
<td>22–42</td>
<td>19–40</td>
<td></td>
</tr>
<tr>
<td>0.600</td>
<td>19–35</td>
<td>15–31</td>
<td>13–30</td>
<td></td>
</tr>
<tr>
<td>0.300</td>
<td>12–25</td>
<td>10–23</td>
<td>9–22</td>
<td></td>
</tr>
<tr>
<td>0.150</td>
<td>8–16</td>
<td>6–14</td>
<td>6–15</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>5–8</td>
<td>4–7</td>
<td>4–7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Binder Content (% by mass)</td>
<td>5.0–7.0</td>
<td>4.5–6.5</td>
<td>4.3–6.3</td>
<td></td>
</tr>
</tbody>
</table>

**Mix properties**

Design criteria: Asphalt mixes to comply with the relevant target volumetric design criteria and other properties listed in this clause, provided that alternative design targets may be specified or agreed for particular applications. Laboratory preparation and compaction of asphalt mixes may be undertaken using either gyratory compaction or the Marshall Method. The design criteria to apply to only one...
method of compaction. Nominate the method of compaction, unless otherwise specified. Also comply with the recommendations of AS 2150.

**Dense graded asphalt**

Dense graded asphalt mixes: Conform to the following:

- Comply with the volumetric design criteria listed in either Tables 2.12 or 2.13 and the Voids Mineral Aggregate (VMA) requirements listed in Table 2.14.
- Design all mixes to have a minimum effective binder film index of 7.5 microns except that high fatigue base is to have a minimum effective design binder film index of 10 microns.

**Table 2.12 Design Requirements for Dense Graded Asphalt Mixes Prepared Using Gyratory Compaction**

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Application</th>
<th>Laboratory compaction level (cycles)</th>
<th>Air voids (%)</th>
<th>Air voids at 250 cycles – min (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic category</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>Wearing and base</td>
<td>60</td>
<td>3.0 – 7.0</td>
<td>–</td>
</tr>
<tr>
<td>Medium</td>
<td>Wearing and base</td>
<td>80</td>
<td>3.0 – 7.0</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>80</td>
<td>2.0 – 4.0</td>
<td>–</td>
</tr>
<tr>
<td>Heavy</td>
<td>Wearing and base</td>
<td>120</td>
<td>3.0 – 7.0</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>80</td>
<td>2.0 – 4.0</td>
<td>–</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>Wearing and base</td>
<td>120</td>
<td>3.0 – 7.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

**Table 2.13 Design Requirements for Dense Graded Asphalt Mixes Compacted by the Marshall Method (50 Blow Compaction)***

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Application</th>
<th>Air voids (%)</th>
<th>Stability – min (kN)</th>
<th>Flow (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic category</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td>Wearing and base</td>
<td>3.0 – 7.0</td>
<td>5.5</td>
<td>2–4</td>
</tr>
<tr>
<td>Medium</td>
<td>Wearing and base</td>
<td>4.0 – 7.0</td>
<td>6.5</td>
<td>2–4</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>2.0 – 4.0</td>
<td>6.5</td>
<td>2–4</td>
</tr>
<tr>
<td>Heavy</td>
<td>Wearing and base</td>
<td>3.0 – 7.0</td>
<td>6.5</td>
<td>2–4</td>
</tr>
<tr>
<td></td>
<td>High fatigue base</td>
<td>2.0 – 4.0</td>
<td>6.5</td>
<td>2–4</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>Wearing and base</td>
<td>3.0 – 7.0</td>
<td>7.0</td>
<td>2–4</td>
</tr>
</tbody>
</table>

Notes:
1. Where 75 blow Marshall compaction is used, the air voids range to be reduced by 1 percentage point.
2. Where 35 blow Marshall compaction is used, the air voids range to be increased by 1 percentage point.

**Table 2.14 Voids Mineral Aggregate (VMA)**

<table>
<thead>
<tr>
<th>Mix nominal size (mm)</th>
<th>VMA (% minimum)</th>
<th>Marshall compaction (50 blow)***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gyratory compaction</td>
<td>Heavy/Very Heavy Traffic Wearing Course Mixes</td>
</tr>
<tr>
<td>7</td>
<td>17</td>
<td>–</td>
</tr>
<tr>
<td>10</td>
<td>16</td>
<td>17</td>
</tr>
<tr>
<td>14</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>20</td>
<td>14</td>
<td>–</td>
</tr>
<tr>
<td>28</td>
<td>13</td>
<td>–</td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>–</td>
</tr>
</tbody>
</table>

Note:
1. Where 75 blow Marshall compaction is used, the VMA targets to be reduced by 1 percentage point.
Mix nominal size (mm) & VMA (% minimum) & Marshall compaction (50 blow'') & Heavy/Very Heavy Traffic Wearing Course Mixes & Other mix types
| Gyratory compaction | point. |

**Design of asphalt mixes incorporating reclaimed asphalt pavement (RAP)**

General: Prepare separate mix designs for all mixes containing RAP. Binder in RAP to be included as binder in the total mix. Alterations to the proportion of RAP constitute a design change.

Requirements: Mixes generally to comply with the design and manufacture requirements specified elsewhere in this worksection with the additional requirements specified in Reclaimed asphalt pavement and the following sub-clauses.

- Asphalt mixes containing not more than 15% of RAP by mass of total mix: Unless otherwise specified, RAP in proportions up to 15% by mass of the total mix to be permitted in all dense graded asphalt mixes.

- Asphalt mixes containing more than 15% but not more than 30% of RAP by mass of total mix: RAP in proportions greater than 15%, but not exceeding 30%, may be used in dense graded asphalt mixes except for Heavy and Very Heavy Duty Wearing Course Mixes, mixes containing polymer modified binder, or where excluded in the Schedule of Job Details. In addition to the requirements specified in Design of asphalt mixes incorporating reclaimed asphalt pavement (RAP), allowance may be made for increase in binder stiffness due to hardened binder in RAP by adoption of bitumen binder one class lower in viscosity than that otherwise specified.

- Asphalt mixes containing more than 30% of RAP: To be accepted only where the Contractor can demonstrate suitable manufacturing plant and quality control procedures to ensure consistent production of hot mix asphalt of a standard not less than that otherwise specified. This constitutes a HOLD POINT.

**Approval of Job mix**

General: If the approval of the job mix is required by the Superintendent, provide the information listed in Table 2.19 at least seven (7) days prior to commencement of production. This is a HOLD POINT.

Identification: Each mix design to be identified by a unique number system allocated by the Contractor or Superintendent in accordance with the accepted practice of the Principal and to be designated the Job Mix.

Submission of Samples: Where specified in the Schedule of Job Details, or on request by the Superintendent, provide samples of the constituent materials used in the proposed mix design. The samples to be provided at the Contractor's expense and delivered to the address specified in the Schedule of Job Details. The quantity of samples to be in accordance with Table 2.20, or as directed by the Superintendent. This is a WITNESS POINT.

Approval to Use Previously Designed Mix: The Superintendent may accept a Job Mix used by the Contractor under other Contracts for the supply of asphalt of the particular type and nominal size specified subject to the following conditions:

- The project work is undertaken within a two-year period of mix design work for the Job Mix.
- The type, quality and sources of all constituent materials remain unchanged.
- The proportions of aggregates and filler are not varied by more than 20% of the proportion of that component in the original Job Mix.
- The in-service performance of the Job Mix materials has been satisfactory. This constitutes a HOLD POINT.

**Table 2.19 Information to be Submitted by Contractor for Approval of Job Mix**

<table>
<thead>
<tr>
<th>Item</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Details of constituent materials required under this Specification including aggregates, filler, binder, additives (if used) and source of materials</td>
</tr>
<tr>
<td>2</td>
<td>The nominated grading, binder content, air voids and proportion of each component in the mix</td>
</tr>
<tr>
<td>3</td>
<td>Test results verifying constituent material properties and test results of trial mixes made at varying binder contents to arrive at the design mix</td>
</tr>
<tr>
<td>Item</td>
<td>Information</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
</tr>
<tr>
<td>4</td>
<td>Test results in accordance with the design requirements specified in Mix properties.</td>
</tr>
</tbody>
</table>
| 5    | The following test results performed on a batch of each mix proposed to be used, and produced from the mixing plant from which the asphalt is to be supplied:  
- Grading  
- Binder Content  
- Maximum density  
- Air voids at laboratory design compaction level |

### Table 2.20 Sample quantities of constituent materials

<table>
<thead>
<tr>
<th>Material</th>
<th>Sample quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Each coarse and fine aggregate component</td>
<td>50 kg</td>
</tr>
<tr>
<td>RAP (if used)</td>
<td>50 kg</td>
</tr>
<tr>
<td>Added Mineral Filler</td>
<td>5 kg</td>
</tr>
<tr>
<td>Binder</td>
<td>8 litres</td>
</tr>
<tr>
<td>Additives</td>
<td>As appropriate</td>
</tr>
</tbody>
</table>

### 3 EXECUTION

#### 3.1 PROVISION FOR TRAFFIC

**General**  
Requirement: Conform to 1101 Control of traffic.

#### 3.2 MANUFACTURE AND STORAGE

**General**  
Plant: Asphalt manufacturing plant to be of sound design and construction and capable of consistently producing asphalt mixes with the properties specified and at a rate suitable for smooth, continuous asphalt placing.

**Storage of raw materials**  
Storage: Store raw materials at the mixing site in sufficient quantities to ensure continuity of production and enable effective sampling and testing prior to use. The facilities for handling particular materials to conform to the following:
- Aggregates: Handle and store in such a manner as to prevent contamination and avoid segregation.
- Filler: Handle and store in such a manner as to keep it dry and free flowing at all times. Where more than one type of filler is to be used, handle and store each separately.
- Additives, including cellulose or mineral fibre: Protect from moisture or contamination. Do not use wet materials.
- Binder tanks for heating and storage of binder: To be thermostatically controlled and each fitted with a thermometer that is located so that the temperature can be read conveniently. Provide a sampling cock in the outlet pipe from each tank.
- Do not heat bitumen binder to more than 185°C. Do not heat or store multigrade and Polymer Modified binders contrary to the temperature and time combinations specified by the manufacturer's written instructions.

**Mixing temperatures**  
Temperature limits: Temperature of bitumen and aggregates at the mixing plant, and the temperature of asphalt as it is discharged from the asphalt plant, not to exceed the limits specified in Table 3.1.1.

### Table 3.1.1 Mixing temperatures

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum temperature (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 170, Class 320, Class AR450 Bitumen delivered into mixer</td>
<td>165</td>
</tr>
<tr>
<td>Class 600 Bitumen delivered into mixer</td>
<td>175</td>
</tr>
</tbody>
</table>
Material | Maximum temperature (°C)  
--- | ---  
Aggregates before mixing with binder | 200  
Asphalt at discharge from asphalt plant | 175\(^1\)  

Note:  
1. The maximum temperature of open graded asphalt not to exceed that determined from the asphalt binder drain-off test, if applicable.

Moisture content  
After completion of mixing: The moisture content of the mix not to exceed 0.5%.

Production tolerances  
Tolerances: Production tolerances on grading and binder content to comply with Table 3.1.2.

<table>
<thead>
<tr>
<th>Description</th>
<th>Maximum Tolerance on Job Mix Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading: Sieve size one size larger than nominal size</td>
<td>Nil</td>
</tr>
<tr>
<td>Pass 26.5 mm sieve or larger</td>
<td>± 10</td>
</tr>
<tr>
<td>Pass 4.75 mm sieve to 19.0 mm sieve inclusive</td>
<td>± 7</td>
</tr>
<tr>
<td>Pass 1.18 mm sieve to 2.36 mm sieve inclusive</td>
<td>± 5</td>
</tr>
<tr>
<td>Pass 0.300 mm sieve to 0.600 mm sieve inclusive</td>
<td>± 4</td>
</tr>
<tr>
<td>Pass 0.150 mm sieve</td>
<td>± 2.5</td>
</tr>
<tr>
<td>Pass 0.075 mm sieve</td>
<td>± 1.5</td>
</tr>
<tr>
<td>Binder Content: Percent by mass of total mix</td>
<td>± 0.3</td>
</tr>
</tbody>
</table>

Source: AS 2150 Table 11.

Storage of mixed asphalt  
Requirements: Store asphalt prior to delivery to the purchaser, and is subject to observation of the following requirements:  
- The mix is consigned to and deposited in the storage bins in such a manner as to minimise segregation.  
- The storage bin to be insulated.  
- The method of discharge to be such as to minimise segregation. Any caked or segregated portions of mix to be discarded.  
- Asphalt with polymer modified binders not to be stored in plant silos for a period longer than eight hours or that recommended by the manufacturer of the polymer modified binder.  
- The total time of storage to be limited to 24 hours unless otherwise approved. Storage of mixed asphalt is a WITNESS POINT.

Asphalt mixes incorporating reclaimed asphalt pavement (RAP)  
Requirements: Only use RAP from stockpiles that have been tested for consistency in grading and binder content with materials used in mix design.  
In batch mixing plants, the RAP to be either:  
- Metered into the asphalt plant after heating and drying of aggregates  
- Added directly to the weigh hopper with the other aggregate materials, for each batch.  
- Weighed separately and added direct to the pugmill.  
Increase batch mixing time, if necessary, to ensure adequate heat transfer and dispersion of RAP.  
Protect RAP in drum mix plants from excessive temperatures by a combination of entry point to the drum and shielding from direct flame contact.

3.3 SAMPLING AND TESTING OF ASPHALT PRODUCTION

General  
Sampling: Arrange for all relevant testing. Samples from asphalt production to be randomly selected (random sampling) by a recognised statistical technique from fresh production asphalt at the asphalt
plant. Do not mix samples. Visually inspect each loaded truck for segregation, uncoated particles, excess bitumen or overheating, before dispatch from the plant.

Testing: Production asphalt to be tested for the following:
- Grading.
- Binder content.
- Maximum density.
- Temperature.

**Frequency of sampling and testing**
Minimum frequency of sampling and testing: As shown in Tables 3.2.1 and 3.2.2. Table 3.2.1 provides for two levels of minimum frequency. The reduced frequency may only be adopted where the process is demonstrated to be under statistical control as specified in Process control.

Where a non-conformance occurs in any test requirement, the frequency of sampling and testing for that particular property to be increased to the normal level until conforming results have been obtained on five consecutive samples. This is a HOLD POINT.

**Costs:** The costs of the required testing shall be borne by the Contractor.

### Table 3.2.1 Frequency of Sampling and Testing of Production Asphalt

<table>
<thead>
<tr>
<th>Test</th>
<th>Normal minimum frequency</th>
<th>Reduced minimum frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grading</td>
<td>One test per 300 t of asphalt plant production</td>
<td>One test per 500 t of asphalt plant production</td>
</tr>
<tr>
<td>Binder content</td>
<td>One test per 300 t of asphalt plant production</td>
<td>One test per 500 t of asphalt plant production</td>
</tr>
<tr>
<td>Maximum density</td>
<td>One test per 300 t of asphalt plant production</td>
<td>One test per 500 t of asphalt plant production</td>
</tr>
<tr>
<td>Temperature</td>
<td>Each loaded truck</td>
<td>Lesser of each loaded truck or one per 15 minutes</td>
</tr>
</tbody>
</table>

### Table 3.2.2 Frequency of Testing of Component Materials

<table>
<thead>
<tr>
<th>Test</th>
<th>Minimum Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Abrasion (where applicable)</td>
<td>3 Monthly</td>
</tr>
<tr>
<td>Unsound and marginal stone content (where applicable)</td>
<td>3 Monthly</td>
</tr>
<tr>
<td>Wet Strength (where applicable)</td>
<td>3 Monthly</td>
</tr>
<tr>
<td>Wet/Dry Variation (where applicable)</td>
<td>3 Monthly</td>
</tr>
<tr>
<td>Flakiness Index of coarse aggregate</td>
<td>Monthly</td>
</tr>
<tr>
<td>Dry compacted voids of combined filler</td>
<td>Monthly</td>
</tr>
<tr>
<td>Added filler (Tables 2.5 and 2.6)</td>
<td>Certification of each delivery</td>
</tr>
<tr>
<td>Binder viscosity</td>
<td>Certification of each delivery</td>
</tr>
<tr>
<td>RAP grading and binder content</td>
<td>One test per 500 t of RAP</td>
</tr>
</tbody>
</table>

**Process control**
Implementation: Implement suitable measures for control of the asphalt process. Process control measures may include the use of statistical process control charts for some, or all, of the tests required in Frequency of sampling and testing and suitable decision rules for determining that the process is under statistical control and therefore subject to reduced minimum frequency of test.

Include in the Quality Plan elements of the process control system that incorporate the application of statistical process control.

### 3.4 DELIVERY

**General**
Transportation: Transport asphalt to the point of delivery in vehicles complying with the following requirements:
- The inside of vehicle bodies to be kept clean and coated with a thin film of an appropriate release agent to prevent asphalt sticking to the body of the vehicle. Take care to remove surplus release agent before loading asphalt into the vehicle.
- After loading with asphalt, cover the body of the vehicle to prevent contamination and reduce the rate of cooling of the mix.
- Where the length of the haul or the weather is such that the temperature of the asphalt may drop below a suitable placing temperature, or where excessive local cooling of the mix may occur, the vehicles are to be suitably insulated.

Work records
Asphalt work record: Particulars of the work performed are to be recorded by the Contractor on the Asphalt Work Record attached as Annexure A or as per the Contractor's own procedures where equivalent. Complete the Asphalt Work Record, which is to be countersigned by the Superintendent each day as a true record of the work performed. Supply a copy to the Superintendent. This is a HOLD POINT.
Delivery dockets: Attach delivery dockets stating the mass of each truck load of asphalt to Annexure A Asphalt Work Record.

3.5 PLACING

Preparation of surface
Cleaning: Prior to tack coating and placing of asphalt, the surface to be free of all deleterious material. Where required, sweep clean the area on which asphalt is to be placed.

Protection of services and road fixtures
Protection: Prevent tack coat, binder, aggregate, asphalt or other material used on the work from entering, adhering or obstructing gratings, hydrants, valve boxes, inspection pit covers, access chamber covers, bridge or culvert decks, kerbs and other road fixtures.
Clean: Immediately after the asphalt has been spread, clean off or remove any such material and leave the services and road fixtures in a satisfactory condition. This is a WITNESS POINT.

Priming
General: Where specified separately, prime crushed rock and gravel pavements.

Tack coating
- Application: Conform to the following:
- Tack coat to be placed between asphalt layers (unless still hot) and on exposed (milled) gravel. In lieu of tack coating new seals the surface is to be broomed until no foreign matter is present
- Apply tack coat to the cleaned surface prior to placing asphalt.
- Tack coat to consist of bituminous emulsion complying with AS 1160. The type and breaking rate to be suitable to the climatic and surface conditions of use such that it is fully broken, free of surface water and intact before the commencement of asphalt spreading.
- Apply tack coat to provide a uniform application rate of residual binder of between 0.10 L/m² and 0.20 L/m².
- Apply tack coat by spray bar fitted to a mechanical sprayer. Perform hand spraying only in those areas where it is impracticable to use a spray bar.
- Take precautions to protect kerbs, gutters, adjoining structures, traffic and parked vehicles from tack coat spray.

Spreading
Placing: Unless otherwise specified, employ self-propelled mechanical pavers to place asphalt except for areas where the use of a paver is impracticable.

Ambient conditions for placing: Conform to the following:
- The surface on which the asphalt is to be placed is to be dry and free from free-standing water.
- Do not place asphalt when the pavement surface temperature is less than 5°C.
- Wearing course asphalt not to be placed when the pavement surface temperature is less than 10°C except that placing at lower temperatures may be permitted subject to agreement on procedures used to compensate for rapid cooling of asphalt materials. This is a HOLD POINT.

Layer thickness: Spread asphalt in layers at the compacted thickness shown on the drawings, or as specified.
Level control: The method of paver level control is specified in the approved CC drawings. If no method is specified, apply suitable automatic or manual screed level controls to achieve the standards specified in Finished pavement properties.

Spreading: Spread asphalt without tearing or segregation and conform to the following:
- Conduct spreading operations to ensure that the paver speed matches the rate of supply so that the number of paving stops is minimised.
- The paver is not to be left stationary for prolonged periods with the screed box in contact with either the previously placed asphalt or loose asphalt in front of the screed.

Compaction
General: Uniformly compact asphalt to the standards specified in Density as soon as the asphalt has cooled sufficiently to support the rollers without undue displacement. Compaction to be achieved using suitable sized steel wheeled or vibratory rollers or combination of steel wheeled or vibratory rollers and pneumatic tyred rollers.

Joints
General: Provide joints as follows:
- Longitudinally, if the width of the pavement is such that more than one paving run is necessary.
- Transversely, after the completion of a day's paving operations, or where a delay in paving operation allows asphalt to cool and adversely affect placing, and elsewhere if a break in a longitudinal run is required.
- The location of joints to be planned before work commences.
- The number of joints to be minimised by adopting good asphalt paving practices.
- All joints to be well constructed and comply with the shape requirements specified in Finished pavement properties. The location of planned joints is a HOLD POINT.

Longitudinal Joints: Conform to the following:
- Longitudinal joints in the wearing course are to coincide with traffic lane lines unless otherwise specified or agreed.
- Longitudinal joints to be offset from layer to layer by not less than 150 mm provided that no joint is placed directly below a trafficked wheel path.

Hot joints: Where asphalt is placed against the edge of a preceding lane that has not cooled below 100°C it is considered a hot joint.
- Construct hot joints by leaving a 150 mm strip of asphalt unrolled along the free edge until the adjoining lane is placed, and then compacting the unrolled strip simultaneously with the material in the adjoining lane.

Warm joints: Where asphalt is placed against the edge of a preceding lane that has not cooled below 60°C it is considered a warm joint.
- Construct warm joints by rolling the full width of the first lane being placed, prior to placing the adjoining lane.

Cold joints: Where asphalt is placed against the edge of a preceding lane that has cooled below 60°C it is considered a cold joint.
- Asphalt placed against a cold edge should overlap the previous edge by 25 mm to 50 mm.
- The overlap should be pushed back using lutes, immediately after spreading, to form a slight ridge that is compacted with the steel wheel roller.

Transverse joints: Offset transverse joints by not less than 2 m in adjoining paver runs and from layer to layer.

3.6 FINISHED PAVEMENT PROPERTIES

Level
Finished level: The level at the top of each course of asphalt not to differ from the specified level by more than 10 mm, except that where asphalt is placed against kerb and gutter, the surface at the edge of the wearing course to be flush with, or not more than 5 mm above, the lip of the gutter, unless otherwise specified or shown on the Drawings.

Alignment
General: The horizontal location of any point on the pavement not to vary by more than ± 50 mm from the corresponding points shown on the documents, except where alignment with an existing pavement
structure is necessary, when the new work is to be joined to the existing work or structure in a smooth manner.

**Thickness**

General: Conform to the following:

- The average total compacted thickness of the combined asphalt courses to be not less than the specified thickness.
- The average thickness of any individual course to be not less than the specified thickness by more than 10%.
- Where confirmation of asphalt thickness is required, determine it by coring to a recognised random sampling plan.

**Shape**

Surface: No point on the finished surface to deviate below a 3 m straightedge, measured between any two points, by more than the tolerances specified in Table 3.5.1.

**Table 3.5.1 Permissible tolerances in surface shape**

<table>
<thead>
<tr>
<th>Layer</th>
<th>Deviations below 3 m straightedge (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy and very heavy traffic roads</td>
</tr>
<tr>
<td></td>
<td>Medium and light traffic roads</td>
</tr>
<tr>
<td></td>
<td>Parallel to centreline</td>
</tr>
<tr>
<td></td>
<td>Transverse to centreline</td>
</tr>
<tr>
<td></td>
<td>Parallel to centreline</td>
</tr>
<tr>
<td></td>
<td>Transverse to centreline</td>
</tr>
<tr>
<td>Wearing course</td>
<td>5</td>
</tr>
<tr>
<td>Intermediate and base</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>16</td>
</tr>
</tbody>
</table>

Ride quality: Determine ride quality where specified in the Schedule of Job Details from the average of three replica runs with a calibrated roughness car, laser profiler or ARRB TR Walking Profiler.

Lane division: Each lane to be divided into homogeneous sections 100 m long. Any length less than 100 m to be included with the section immediately preceding it and an average roughness determined for the section. Start and finish joints of the entire work, and bridge expansion joints, not to be included in any section.

Roundabouts not to be measured under **Shape**.

**Density**

Testing: Compliance testing of asphalt to be undertaken on a lot-by-lot basis. A pavement lot is an essentially homogeneous section of work completed within a shift of production, unless otherwise specified in the approved CC drawings.

Density testing is not to be performed on:

- Lots of less than 30 t.
- Layers with a nominal thickness less than 30 mm.
- Layers with a nominal thickness less than 2.5 times the nominal mix size, or open graded asphalt.

Location: The location of each in situ density test to be chosen by a method of random stratified sampling. For core sample tests, the layer thickness is the mean thickness of the core samples and for nuclear and impedance density gauge tests, the layer thickness is the nominal thickness. Repair all core holes by an appropriate method that is compatible with the pavement from which cores have been taken.

Perform density testing as soon as practicable after completion of work.

Relative compaction is the percentage ratio of the in situ density of the compacted asphalt and the reference density of the asphalt of a particular lot. The reference density is to be the mean of the five most recent maximum density measurements of the same mix, provided that:

- The tests have been completed within the previous 4 weeks
- The binder content of samples tested is within ± 0.3% of the job mix binder content
- There has been no change in the mix components or proportions.
Where 5 tests complying with the above conditions are not available, carry out a minimum of 5 tests in order to establish the reference density.

The characteristic value of relative compaction is calculated as (Mean – KS)

where:

Mean = The mean of the relative compaction results.

S = The sample standard deviation of the relative compaction results.

K = A factor that depends on the number of tests as shown in Table 3.5.2.

<table>
<thead>
<tr>
<th>Number of tests or measurements</th>
<th>Acceptance constant (K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>0.72</td>
</tr>
<tr>
<td>7</td>
<td>0.76</td>
</tr>
<tr>
<td>8</td>
<td>0.78</td>
</tr>
<tr>
<td>9</td>
<td>0.81</td>
</tr>
<tr>
<td>10</td>
<td>0.83</td>
</tr>
</tbody>
</table>

The work represented by a lot to be assessed as the characteristic value of in situ voids where:

Characteristic value of in situ air voids (%) = 100 – Characteristic relative compaction.

The value of characteristic voids to comply with the maximum characteristic values specified in Tables 3.5.3 and 3.5.4.

<table>
<thead>
<tr>
<th>Asphalt Type and Thickness (mm)</th>
<th>Maximum Characteristic Value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All heavy and very heavy traffic asphalt wearing courses</td>
<td>8</td>
</tr>
<tr>
<td>Medium traffic wearing course.</td>
<td>9</td>
</tr>
<tr>
<td>Light traffic wearing course</td>
<td>7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asphalt type and thickness (mm)</th>
<th>Maximum characteristic value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy and very heavy traffic mixes in layers ≤ 40 mm</td>
<td>8</td>
</tr>
<tr>
<td>Medium and light traffic mixes in layers ≤ 40 mm</td>
<td>9</td>
</tr>
<tr>
<td>Heavy and very heavy traffic (except high fatigue base) mixes in layers &gt; 40 mm</td>
<td>7</td>
</tr>
<tr>
<td>Medium and light traffic mixes in layers &gt; 40 mm</td>
<td>8</td>
</tr>
<tr>
<td>High fatigue base</td>
<td>6</td>
</tr>
</tbody>
</table>

The procedures and results of density testing constitute a WITNESS POINT.

4 MEASUREMENT AND PAYMENT

NOTE: This item is an optional condition for development, required for council project.

4.1 MEASUREMENT

General
Scope: Measurement for payment will include all works shown on the plans or as specified but will not include asphalt lost in transit, works not shown on the plans and variations in quantities due to variations in actual thickness exceeding the specified tolerances.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

4.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>---------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>1144.1 Mix design</strong></td>
<td>Ls</td>
<td>All costs associated with mix design and control.</td>
</tr>
</tbody>
</table>

**Measurement by mass**

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1144.2 Supply and install asphalt measured by mass unless otherwise specified in the Schedule of Job Details</strong></td>
<td>Tonnes.</td>
<td>All costs associated with supply, install and finishing of asphalt.</td>
</tr>
<tr>
<td>- Determine the mass in tonnes from docket supplied by the Contractor and issued at a certified weighing system by batch weights using certified scales approved by the Superintendent.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Measurement by area and thickness**

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1144.2 Supply and install asphalt determined from measurement of area and thickness where specified in the Schedule of Job Details</strong></td>
<td>Tonnes.</td>
<td>All costs associated with supply, install and finishing of asphalt.</td>
</tr>
<tr>
<td>- Determine the mass in tonnes by multiplying the area and thickness determined from the dimensions on the plans or as specified for the work being measured by the density of asphalt in a lot taken as the arithmetic mean of the insitu densities of the lot.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 4.3 NON COMPLYING MATERIALS

**Non compliance**

General: In the event that the material supplied is not within the tolerances and standards defined for manufacture or placing of asphalt, the Superintendent may direct:

- The removal of non complying material; or,
- With the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service. This disposition of non-complying material is a **HOLD POINT**.

### 4.4 RESERVED

### 5 RESERVED
## Annexure A: Asphalt Work Record

### CLIENT:
- **Date:**
- **Contract No.:**
- **Work Location:** km to: km
- **Road Name:**
- **Supplier:**
- **From:**
- **Towards:** (Crossroad or landmark)
- **Road No.:**
- **Job No.:**
- **PMS/MMS Segment Numbers:**

### Plan No.: Mix Type: New Surfacing ☐ Resurfacing ☐ Existing Surface Type:

<table>
<thead>
<tr>
<th>Load No.</th>
<th>Time</th>
<th>Paving Chainage</th>
<th>Delivery</th>
<th>Weather Work Stoppages, Start &amp; Finish etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depot Plant</td>
<td>Arrive Job</td>
<td>Depart Job</td>
<td>Truck Reg’d No.</td>
<td>Docket No.</td>
</tr>
<tr>
<td>Remarks:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Penciller: Sampling by: Superintendent’s Representative: (Signature) Contractor’s Representative: (Signature)

Affiliation: Affiliation:

© AUS-SPEC (Oct 12) 19 Feb 2015
1144 Asphaltic concrete (Roadways)

7 RESERVED
1145 SEGMENTAL PAVING

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide segmental paving, as documented.

Performance
Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1113 Stabilisation.
- 1121 Open drains, including kerb and gutter.
- 1132 Lean mix concrete subbase.
- 1133 Plain and reinforced concrete base.
- 1141 Flexible pavement base and subbase.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:

Note: Only the most current standards are to be used

Australian standards
AS 1141 Methods for sampling and testing aggregates
AS 1141.11.1.1 Particle size distribution — Sieving method
AS 2876 Concrete kerbs and channels (gutters) — Manually or machine placed.
AS 3705 Geotextiles—identification, marking and general data
AS/NZS 4455 Masonry units, pavers, flags and segmental retaining wall units
AS/NZS 4455.2 Pavers and flags
AS/NZS 4456 Masonry units and segmental pavers — Methods of test
AS/NZS 4456.3 Determining dimensions
AS/NZS 4456.5 Determining the breaking load of segmental pavers and flags
AS/NZS 4456.9 Determining abrasion resistance
AS/NZS 4456.10 Determining resistance to salt attack
AS/NZS 4586 Slip resistance classification of new pedestrian surface materials
AS/NZS 4663 Slip resistance measurement of existing pedestrian surfaces

Austroads
AGPT04G Guide to pavement technology: Part 4G Geotextiles and geogrids

Other publications
Concrete Masonry Association of Australia
CMAA MA56 Guide to permeable interlocking concrete pavements
CMAA MA57 Guide to concrete segmental and flag pavements - guide to specifying
CMAA T45 Concrete segmental pavements - Design guide for residential access ways and roads
CMAA T46 Concrete segmental pavements - Detailing guide
1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- CMAA: Concrete Masonry Association of Australia.

Definitions
General: For the purposes of this worksection the following definitions apply:
- Concrete segmental pavers: Units of not more than 0.10 square metres in gross plan area, manufactured from concrete, with top and bottom faces parallel, with or without chamfered edges and identified by the following shape types:
  - Shape Type A: Dentated chamfered units which key into each other on four sides, are capable of being laid in herringbone bond, and by plan geometry, when interlocked, resist the spread of joints parallel to both the longitudinal and transverse axes of the units.
  - Shape Type B: Dentated units which key into each other on two sides, are not (usually) laid in herringbone bond, and by plan geometry, when keyed together, resist the spread of joints parallel to the longitudinal axes of the units and rely on dimensional accuracy and accuracy of laying to interlock on the other faces.
  - Shape Type C: Units which do not key together rely on dimensional accuracy and accuracy of laying to develop interlock.
- Laying patterns: Herringbone, Basketweave, stretcher, or zig zag running bond.
- Lippage: Height deviation between adjacent pavers.

1.5 SUBMISSIONS

Approvals
Submissions: To the Superintendent’s approval. Submit the following for approval:
- Drawings.

1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GENERAL – Nominated materials</td>
<td>Submit segmental paving materials and supplier.</td>
<td>2 weeks before ordering</td>
<td>Superintendent &amp; Councils Engineering Development Officer for Developments.</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUBGRADE PREPARATION – Dimensions and specification</td>
<td>Present the finished subgrade for approval</td>
<td>1 working day before proceeding</td>
<td>Superintendent &amp; Councils Engineering Development Officer for Developments.</td>
</tr>
<tr>
<td>SUBBASE – Dimensions and specification</td>
<td>Present finished subbase for approval</td>
<td>1 working day before proceeding</td>
<td>Superintendent &amp; Councils Engineering Development Officer for Developments.</td>
</tr>
<tr>
<td>BASE – Dimensions and specification</td>
<td>Present the finished base for approval</td>
<td>2 working days before proceeding</td>
<td>Superintendent &amp; Councils Engineering Development Officer for Developments.</td>
</tr>
</tbody>
</table>
WITNESS POINTS table

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAND BEDDING COURSE - Screeding</td>
<td>Re-inspect screed left more than 1 day</td>
<td>Progressive</td>
</tr>
<tr>
<td>COMPLETION - Inspection</td>
<td>Regularly inspect joints after completion</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Program for the works
Planning: Conform to the following:
- Provide planning resources to allocate plant and personnel for the contract period.
- Program the work to meet the constraints of HOLD POINTS and WITNESS POINTS.

3 MATERIALS

3.1 GENERAL

Nominated materials
Submissions: Submit details of all proposed segmental paving materials, including the following:
- Sand: Provide certification of the grading and quality to AS 1141.11.1.
- Segmental pavers: Submit the following type test results from NATA registered laboratory:
  - Characteristic breaking load and flexural strength: To AS/NZS 4456.5.
  - Dimensional deviations: To AS/NZS 4456.3.
  - Abrasion resistance: To AS/NZS 4456.9.
  - Salt attack resistance grade: To AS/NZS 4456.10.
  - Slip resistance type test: To AS/NZS 4586.
- The source of supply.
Testing authority: NATA registered laboratory.
Approval: Do not deliver materials until the Superintendent and the Councils Engineering Development Officer for Developments has approved the nominated materials. Inspection type: HOLD POINT.
NOTE: Clay pavers are not be used for Great Lakes Council works.

3.2 CONCRETE SEGMENTAL PAVERS

Standards
General: To AS/NZS 4455.2.
Concrete segmental paving: To CMAA MA57, CMAA T45 and CMAA T46.
Permeable interlocking concrete pavers: To CMAA MA56.
Dimensional deviations: To AS/NZS 4455.2 Table 2.2(A) and AS/NZS 4455.2 Table 2.2(B).
Properties
Minimum material and dimensional requirements: To AS/NZS 4455.2 Table 2.8.
Salt attack resistance grade: to AS/NZS 4455.2 Table 2.7.
Slip resistance classification: To AS 4586.
Proprietary product: Conform to the SELECTIONS schedule.
3.3 SAND

General
Quality: Provide well-graded, clean, hard sand, with uncoated grains of uniform quality and free of soluble salts or other contaminants which may cause efflorescence.
Storage: Cover sand on site to protect from rain.
Cement: Do not use cement bound material.

Bedding sand
Grading: Obtain material from a single source or blend to conform to the Bedding sand grading table.

<table>
<thead>
<tr>
<th>AS Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.52 mm</td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>95–100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>80–100</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>50–85</td>
</tr>
<tr>
<td>600 µm</td>
<td>25–60</td>
</tr>
<tr>
<td>300 µm</td>
<td>10–30</td>
</tr>
<tr>
<td>150 µm</td>
<td>5–15</td>
</tr>
<tr>
<td>75 µm</td>
<td>0–10</td>
</tr>
</tbody>
</table>

Grading for permeable pavements: To CMAA MA56 Section 9.
Moisture content: 4 – 8% and uniform when spread.

Joint filling sand
Grading: Conform to the Joint filling sand grading table.

<table>
<thead>
<tr>
<th>AS Sieve</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.36 mm</td>
<td>100</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>90–100</td>
</tr>
<tr>
<td>600 µm</td>
<td>60–90</td>
</tr>
<tr>
<td>300 µm</td>
<td>30–60</td>
</tr>
<tr>
<td>150 µm</td>
<td>15–30</td>
</tr>
<tr>
<td>75 µm</td>
<td>5–10</td>
</tr>
</tbody>
</table>

Grading for permeable pavements: To CMAA MA56 Section 9.
Moisture content: Dry when spread.

3.4 GEOTEXTILE MATERIALS

General
Standard: To AS 3705 and AGPT04G.

3.5 CONCRETE FOR EDGE RESTRAINTS

Properties
General: To 0319 Minor concrete works.
Strength: If not shown on the drawings, or provided by kerb and/or gutter, provide concrete edge restraints for pavers with the following minimum 28-day characteristic compressive strength:
- Edge restraints for pavers on road pavements: 32 MPa.
- Edge restraints for pavers on medians, traffic islands and driveways: 25 MPa.
3.6 SELECTIONS

Pavers
Restrains: Select pavers to the Paver Schedule, or as indicated on the approved drawings, or as required by the Conditions of Development Consent.

Paver schedule

<table>
<thead>
<tr>
<th>Property</th>
<th>PAV1</th>
<th>PAV2</th>
<th>PAV3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shape type / shape name.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laying pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum characteristic breaking load</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensional deviation category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abrasion resistance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt attack resistance grade</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slip resistance classification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 SUBGRADE PREPARATION

Dimensions and specification
General: Prepare subgrade to the required depth below the finished surface level as shown on the drawings and conform to 1112 Earthworks (Roadways).
Inspection type: HOLD POINT.

4.3 SUBBASE

Dimensions and specification
Construction: If shown on the drawings, construct a subbase or working platform, to conform to the following:
- 1113 Stabilisation.
- 1132 Lean mix concrete subbase or 1141 Flexible pavements base and subbase as appropriate.
Inspection type: HOLD POINT.

4.4 BASE

Dimensions and specification
Construction: To 1133 Plain and reinforced concrete base or 1141 Flexible pavements base and subbase, as appropriate.
Inspection type: HOLD POINT.
Extent: Extend the base course in width to at least the rear face of all new edge restraints.
Tolerances
Deviation from a 3 m long straightedge: ±6 mm.
Remedial work: Do not use sand bedding material as a levelling material to compensate for base finishing outside the above tolerances.
Base surface drainage: Free without ponding.
4.5 EDGE RESTRAINTS

General
Extent: Provide edge restraints along the perimeter of all segmental paving as shown on the drawings. Make sure the faces of edge restraints abutting pavers are vertical.
Edge restraint support: On compacted base and/or subbase.

Joints
Contraction joints: Provide contraction joints 20 mm deep at maximum spacing of 3 m.

Kerbs and/or gutters, and edge strips
General: To AS 2876.
Construction: To 1121 Open drains including kerb and gutter and 0319 Minor concrete works.

Backfilling
Timing: Backfill at least 3 days after placing concrete.
Compaction: Backfill behind the edge restraint with earth, compacted in layers not greater than 150 mm thick, and complete with topsoil to finished design levels.

4.6 SAND BEDDING COURSE

Geotextile
Position: Place fabric over prepared base course before laying the sand bedding course.

Screeding
General: Spread the sand bedding course in a single uniform layer and screed in a loose condition to the nominated design profile and levels to achieve a uniformly thick nominal 20 mm to 30 mm layer following final compaction of the segmental paving.
Progressive screeding: Do not screed more than 2 m in advance of the laying face at the completion of work on any day.
Depressions: Before laying pavers, loosen, rake and re-screed any depressions in the screeding sand exceeding 5 mm.
Remediation: If screeded sand left overnight is subject to rain, check for level and re-screed where necessary before pavers are placed.
Inspection type: WITNESS POINT.

Drainage
Bedding course drainage: If water ponding occurs at edge restraint, drain bedding course to existing subsurface drain or drainage pit using geotextile and 20 mm diameter PVC pipe.

Compaction
Moisture content: Prepare a trial section to establish the moisture content limits which will allow paver system compaction to be achieved.
Manual placing of pavers: Maintain the bedding sand at a uniform loose density.
Mechanised laying: Provide firm, uniform but not full compaction.

4.7 LAYING PAVERS

Manual laying
Placement and jointing: Uniformly place pavers on the screeded sand bedding to the documented laying pattern. Lay the pattern at either 90° or 45° to the line of edge restraints.
Joints: Lay pavers with uniform 3 mm nominal joint widths to provide a finished 2 mm to 4 mm joint range after bedding compaction and joint filling operations.
Variation: Mix the pavers between pallets to evenly distribute colour variation between pallets over the paved area.
Sequence: Lay first row next to edge restraint or established straight line.
Odd shapes: In each row, first lay the full units and follow with cut closer units. Do not use cut pieces smaller in size than one quarter of a full block.

Laying around obstacles
Concrete surround: Finish public utility access pits, drainage pits and similar penetrations in the pavement with a concrete surround, conforming to the following:
- Minimum thickness between the utility pit and adjacent pavers: 100 mm.
- Strength grade: N32.
- Plan shape: Square or rectangular.

Pit covers: Adjust the levels of the pit covers before paving around them. Make sure the water drains away from closed pits.

Precast access chamber: Lay pavers to suit specific dimensions of authority access chambers.

Patterns around obstacles: Lay up both sides of the feature from the main or original laying face.

**Control joints**
Location: If pavers are placed over an isolation, contraction or expansion joint in an underlying concrete base, provide a control joint in the segmental paving.

Joint: 10 mm thick preformed jointing material of bituminous fibreboard.

**Protection**
Foot or barrow traffic: Provide boards overlaying paving to prevent disturbance of pavers before compaction.

Construction traffic: Do not allow construction traffic on the pavement before compaction and joint filling.

### 4.8 BEDDING COMPACTION

**Method**
Compactor: Compact the sand bedding after laying the pavers with not less than two passes of a high frequency low amplitude plate compactor which covers at least 12 units.

Lippage: Maximum 2 mm level difference between the adjoining edges of any two pavers.

Damage: Replace any pavers which are damaged during bedding compaction and re-compact the pavement for at least 1 m surrounding each replacement unit.

Progressive compaction: Arrange the paving operations as follows:
- Progressively compact behind the laying face.
- Complete compaction of laid paving at end of each day.
- Do not compact within 1 m of laying face except where adjacent to edge restraint.

**Finished levels**
Maximum deviation of finished surface level from the design level: ± 6 mm.

Finished level of edge restraints and drainage inlets: Minimum 5 mm below the finished paving level.

### 4.9 FILLING JOINTS

**Timing**
Compaction: Complete all compaction before filling joints. Complete joint filling of laid paving at the end of each day.

**Method**
Spreading: Spread the joint filling sand over the pavement and fill the joints by brooming.

Compaction: After spreading, make one or more passes of a plate compactor and refill the joints. Repeat the process until the joints are completely filled.

### 4.10 COMPLETION

**Protection**
Restrictions: Do not allow traffic to use the pavement until compaction and joint filling operations have been completed.

Exceptions: Foot and barrow traffic, wheeled trolleys, forklifts and cluster-clamp vehicles.

**Opening to traffic**
Excess sand: Remove excess joint filling sand before opening to traffic.

**Inspection**
Joint filling: Inspect the pavement at regular intervals during the Defects Liability Period to make sure that all joints remain completely filled.

Inspection type: WITNESS POINT.
4.11 LIMITS AND TOLERANCES

Application
Summary: The limits and tolerances applicable to the various clauses in this worksection are summarised in the Summary of limits and tolerances table.

Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/tolerances</th>
<th>Worksection clause reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>± 6 mm</td>
<td>BASE</td>
</tr>
<tr>
<td>Maximum deviation from a 3 mm straightedge.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laying paving units</td>
<td></td>
<td>LAYING PAVERS</td>
</tr>
<tr>
<td>Joint widths</td>
<td>2 mm - 4 mm</td>
<td></td>
</tr>
<tr>
<td>Completed segmental paving</td>
<td></td>
<td>BEDDING COMPACTION</td>
</tr>
<tr>
<td>Maximum deviation of surface level from design level for roads.</td>
<td>± 6 mm</td>
<td></td>
</tr>
<tr>
<td>Level adjacent to drainage inlets</td>
<td>Minimum 5 mm below the finished paving level.</td>
<td>BEDDING COMPACTION</td>
</tr>
<tr>
<td>Lippage - Difference in level of adjacent pavers</td>
<td>≤ 2 mm</td>
<td></td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and PAY ITEMS 1145.1 to 1145.2 inclusive.
Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
- Excavation and preparation of subgrade: To 1112 Earthworks (Roadways).
- Subbase and Base: To 1113 Stabilisation and 1141 Flexible pavements base and subbase or 1132 Lean mix concrete subbase, as appropriate.
- Kerb and/or gutter: To 1121 Open drains, including kerb and gutter.
- Edge strips: In conformance with this worksection and not 0319 Minor concrete works.
- Miscellaneous minor concrete work not included in the pay items in this worksection: To 0319 Minor concrete works.

5.2 PAY ITEMS

Pay items

<table>
<thead>
<tr>
<th>Pay Items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
</table>
| 1145.1 Edge strips | Linear metre  
Measured along the length of the edge strip | All costs associated with the following: Excavation, forming, concreting, contraction joints, backfilling and |
<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>compaction adjacent to the completed edge strip.</td>
</tr>
<tr>
<td>1145.2 Segmental paving—</td>
<td>m²</td>
<td>All costs associated with the following:</td>
</tr>
<tr>
<td>Road pavements</td>
<td></td>
<td>Supply, laying and compaction of segmental paving units, bedding sand and joint</td>
</tr>
<tr>
<td></td>
<td></td>
<td>filling sand.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cutting of units.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Joints overlying concrete pavement joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concrete surrounds or aprons around surface penetrations.</td>
</tr>
</tbody>
</table>
1171 SUBSURFACE DRAINAGE

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide subsurface drainage, as documented.

Performance
Requirements: Conform to the requirements of this specification, the drawings and directions of the Superintendent.

Design
Designer: Suitably qualified to RP Eng/CP Eng standard to authorise design by signature.

Authority requirements: As required by the Conditions of Development Consent

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation.
- 1112 Earthworks (Roadways).

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used

AS 1141 Methods for sampling and testing aggregates.
AS 1141.11.1 Particle size distribution by dry sieving.
AS 1141.22 Wet/dry strength variation.
AS 1289 Methods of testing soils for engineering purposes.
AS 1289.5.5.1 Soil compaction and density tests - Determination of the minimum and maximum dry density of a cohesionless material - Standard method.
AS 1289.5.6.1 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material

AS/NZS 1477 PVC pipes and fittings for pressure applications.
AS 2439 Perforated plastics drainage and effluent pipe and fittings.
AS 2439.1 Perforated drainage pipe and associated fittings.
AS 2758 Aggregates and rock for engineering purposes.
AS 2758.1 Concrete aggregates.
AS 3705 Geotextiles - Identification, marking and general data.
AS 3706 Geotextiles - Methods of test.
AS 3706.9 Determination of permittivity, permeability and flow rate.
AS 3706.11 Determination of durability—Resistance to degradation by light, heat and moisture.

Other publications
AUSTROADS
AGPT04G Guide to Pavement Technology Part 4G- Geotextiles and geogrids
AGPT10 Guide to Pavement Technology Part 10—Subsurface drainage
ASTM D2434-68 Standard Test method for permeability of granular soils (Constant head)
1.4 STANDARDS

General
Standard: To AGPT10.

1.5 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply.
Panel drain: Corrugated flat plastic pipe.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.

Documents
Submit the following for approval:
- Materials: Off-site certificates of components.
- Calculations: Survey set out of drainage works and quantity calculations.
- As-executed drawings: Include drainage system information sheets and works.
- Components: Pipes and fittings, and geotextiles.
- Samples: For conformity testing to relevant Standards.
- Technical data: System drainage information.
- Execution details: Refer to HOLD POINTS.

1.7 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsurface drainage pipes - General</td>
<td>Submit compliance certificates</td>
<td>7 days before proceeding to provide pipes</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Other types of subsurface drainage pipes - Alternatives</td>
<td>Submit details of proposed alternative pipes and evidence of conformity for approval.</td>
<td>7 days before proceeding to provide pipes</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Geotextile - General</td>
<td>Provide documentation of conformity of geotextile and installation process</td>
<td>14 days before proceeding to provide geotextile</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment - Set out</td>
<td>Submit the proposed set-out in addition to the designed set-out</td>
<td>7 days before planned execution</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Excavation – Existing under ground services</td>
<td>Submit evidence of approval of the relevant authorities.</td>
<td>14 days before planned excavation</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Excavation - Trenches</td>
<td>Approval of completed trenches required prior to installation of drainage work</td>
<td>1 working day prior to installation of drainage work</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Recording of subsurface drainage - Information sheet</td>
<td>Progressive supply of subsurface drainage details</td>
<td>5 working days after completion of each drain or drainage system</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>
WITNESS POINTS table – Off-site activities

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsurface drainage pipes - Corrugated flat plastic pipe and fittings</td>
<td>Type of pipe and fitting</td>
<td>7 days prior to proceeding</td>
</tr>
<tr>
<td>Subsurface drainage pipes - Thick walled P.V.C. pipe</td>
<td>Certificate of compliance</td>
<td>7 days prior to proceeding</td>
</tr>
</tbody>
</table>

WITNESS POINTS table – On-site activities

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary drainage during construction, Equipment and material</td>
<td>Locate materials and equipment clear of water courses</td>
<td>7 days prior to positioning</td>
</tr>
<tr>
<td>Excavation, Blasting operation</td>
<td>Measure ground vibration resulting from blasting</td>
<td>Progressive</td>
</tr>
<tr>
<td>Outlet structures, Discharge and salinity prevention</td>
<td>Locate discharge to avoid recharge of water table</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Program of works
General: Program the works as follows:
- Materials: Arrange the program for compliance and usage of component and materials.
- Authorities: Arrange approvals and confirm environmental requirements.

3 MATERIALS

3.1 SUBSURFACE DRAINAGE PIPES

General
Approval: Before providing pipes, submit compliance certificate and test results determined from AS 2439.1 as evidence that the pipes conform to the requirements of this worksection. This is a HOLD POINT.

Corrugated circular plastic pipe and fittings
Pipe: Conform to the following:
- Standard: To AS 2439.1.
- Class: 1000, for 65 mm or 100 mm diameter as shown on the drawings.
- Type: Slotted, except where shown otherwise on the drawings.
Fittings: Provide joints, couplings, elbows, tees and caps as follows:
- To AS 2439.1.
- To the manufacturer’s recommendations.

Corrugated flat plastic pipe and fittings
Pipe: Conform to the following: This is a WITNESS POINT.
- Type: ‘Stripdrain’ or ‘Megalfo’ or approved equivalent enclosed in geofabric or seamless tubular filter fabric.
- Size: As shown on the drawings.
- Fittings: To the manufacturer’s recommendations.
Thick walled PVC pressure pipe
Pipe: Conform to the following:
- To AS/NZS 1477.
- Size:
  - Nominal diameter: 58 mm.
  - Minimum wall thickness: 6.5 mm.
- Type: Slotted except where shown on the drawings. Details of slot sizes and spacings to Annexure A.
Joints: Square ends and butt jointed.
Certificate of Compliance: Submit a test certificate to AS/NZS 1477. This is a WITNESS POINT.

3.2 OTHER TYPES OF SUBSURFACE DRAINAGE PIPES

Alternatives
Approval: Submit full details of the type of pipe, certification from the manufacturer of its suitability and quality for use in each particular application. Address the crushing strength, flexural strength, jointing system and slotting details. This is a HOLD POINT.

3.3 FILTER MATERIAL

General
Quality: Clean, hard, tough, durable particles.
Where subsoil drains are laid in or adjacent to planted area's: Ensure the PH of the filter material is within the range 6 – 7.
Includes recycled crushed glass with a material size of 3m to 6m for use as a filler material which is in conformance with table 2 of 2010 Green Spec.
Compaction: Compact cohesionless material to a Density Index of 70% determined by AS 1289.5.6.1.

Type A filter material
Source: Crushed rock or granular material.
Grading: To the Type A filter material table.
Use: In trench drains and Type B drainage mats: To 1174 Drainage mats.

Type A filter material table

<table>
<thead>
<tr>
<th>Test method</th>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1141.11.1</td>
<td>Material passing AS sieve</td>
<td>% by mass</td>
</tr>
<tr>
<td>6.7 mm</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td></td>
<td>85 to 100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td></td>
<td>0 to 40</td>
</tr>
<tr>
<td>1.18 mm</td>
<td></td>
<td>0 to 5</td>
</tr>
<tr>
<td>425 μm</td>
<td></td>
<td>0 to 2</td>
</tr>
</tbody>
</table>

Type B filter material
Source: Granular material.
Grading: To the Type B filter material table.
Coefficient of saturated permeability: At least 8 m / day after three hours of flow when compacted to its maximum dry density in conformance with AS 1289.5.5.1 and then tested to conform with ASTM-D2434-68.
Grading variation as a result of compaction processes: To the Type B filter material variation table.
Use: In trench drains and Type A drainage mats: To 1174 Drainage mats.

Type B filter material table

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1141.11.1</td>
<td>Material passing AS sieve</td>
<td>% by mass</td>
</tr>
<tr>
<td>4.75 mm</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td></td>
<td>95 to 100</td>
</tr>
</tbody>
</table>
Type B filter material variation table

<table>
<thead>
<tr>
<th>AS Sieve</th>
<th>Variation from grading before treatment (% of mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.36 mm</td>
<td>± 3</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>± 1</td>
</tr>
<tr>
<td>425 µm</td>
<td>± 1</td>
</tr>
<tr>
<td>300 µm</td>
<td>± 1</td>
</tr>
<tr>
<td>150 µm</td>
<td>± 0.5</td>
</tr>
<tr>
<td>75 µm</td>
<td>± 0.1</td>
</tr>
</tbody>
</table>

Type C filter material
Source: Crushed rock.
Grading: To the Type C filter material table.
Use: In Type A drainage mats: To 1174 Drainage mats.

Type C filter material table

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1141.11.1</td>
<td>Maximum particle size</td>
<td>37.5 mm</td>
</tr>
<tr>
<td></td>
<td>Maximum passing the 9.5 mm AS Sieve</td>
<td>5% by mass</td>
</tr>
<tr>
<td></td>
<td>Maximum (D90:D10)* or (see Note)</td>
<td>3</td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Minimum wet strength</td>
<td>100 kN</td>
</tr>
<tr>
<td></td>
<td>Maximum 10% fines wet/dry variation</td>
<td>30%</td>
</tr>
</tbody>
</table>

Note: The D90 value is determined by sieving the material using 75 mm, 53 mm, 37.5 mm, 26.5 mm, 19 mm, 13.2 mm and 9.5 mm AS sieves, as appropriate, and then plotting the results on a graph of AS sieve size vs percentage passing. The plotted points to be joined by straight lines and the D90 value determined as the theoretical sieve size corresponding to 90% passing.
D10 denotes the theoretical size of a sieve through which 10% of the material would pass and is to be determined from the same graph used to determine the D90 value.

Type D filter material
Source: Uncrushed river gravel.
Description: Rounded aggregate to AS 2758.1 Table B1 Appendix B.
Grading: To the Type D filter material table.
Use: In Type A and Type B drainage mats: To 1174 Drainage mats.

Type D filter material table

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1141.11.1</td>
<td>Maximum particle size</td>
<td>75 mm</td>
</tr>
<tr>
<td></td>
<td>Maximum passing the 9.5 mm AS sieve</td>
<td>5% by mass</td>
</tr>
<tr>
<td></td>
<td>Maximum (D90 : D10)</td>
<td>3</td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Minimum wet strength</td>
<td>100 kN</td>
</tr>
<tr>
<td></td>
<td>Maximum 10% fines wet/dry variation</td>
<td>30%</td>
</tr>
</tbody>
</table>

3.4 GEOTEXTILE

General
Conformity: Prior to placing geotextiles, produce documentary evidence that the geotextile and installation process conform to the requirements of this worksection. This is a HOLD POINT.
Properties
Material: A non-woven type manufactured from synthetic materials other than polyamide except seamless tubular filter fabric.
General properties: Bio-stable and resistant to attack by alkalis, acids, dry heat, steam, moisture, brine, mineral oil, petrol, diesel and detergents when tested to AS 3706.
Ultra violet light considerations: Conform to the following:
- Provide geotextile resistant to ultra violet light.
- Do not leave geotextile exposed to sunlight during storage and construction for more than 21 days.
- If exposure is in excess of 21 days provide annual test results to conform with AS 3706.11 to show percentage strength retained is in excess of 60 %.
Robustness and strength: Conform to the following:
- Conform to the classifications for robustness and strength cited in AGPT04G.
- Select material based on tests and subgrade conditions for the relevant location/function.
Properties: Material type and minimum mass requirements as shown on the drawings.
Installation: Properties, functions, design and construction requirements to AUSTROADS AGPT04B/09.
Water transmission properties: Conform to the following:
- Geotextile materials for curtain drains: Polyester, polypropylene or polyethylene.
- Rate of water flow: To AGPT04G Table 4.1, under 100 mm constant head determined using the perpendicular flow test to conform with AS 3706.9.

Marking and storage
Labelling: Mark rolls with product identification and supply with data sheets and information to AS 3705.
Covering: Provide each roll of geotextile with a suitable covering to protect the fabric against moisture and ultraviolet radiation, and mark to conform with AS 3705.
Storage: Prior to installation store the geotextiles under a protective cover and supported off the ground. Protect the geotextile from damage and adhere to any other recommendations on method of storage set by the supplier/manufacturer.

Seamless tubular filter fabric
Material: Either polypropylene or polyester seamless knitted tubular filter fabric.
Arrangement: Enclose slotted pipe of 65 mm or 100 mm diameter.
Properties: Free of imperfections in weave or yarn, abrasion resistance and weave stability qualities such that it does not form holes, ladder, de-weave, tear or unravel more than 5 mm from a cut end. Representative large opening size: Between 200 and 500 μm.
Fitting: To the requirements of Procedure for fitting seamless tubular filter fabric to slotted pipe Annexure A.
Damaged filter fabric: Remove and replace filter fabric that is torn, excessively stretched or otherwise damaged during transportation, storage, fitting of the fabric or pipe laying.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Control of traffic: Conform to the following:
- Conform with worksection 1101 Control of traffic.
- Conform with Traffic Guidance Scheme in 1101 Control of traffic.

4.2 TEMPORARY DRAINAGE DURING CONSTRUCTION

Erosion control
Installation: To 1102 Control of erosion and sedimentation.
Runoff overflows during construction
Works under construction: Provide for runoff to avoid damage or nuisance due to scour, sedimentation, soil erosion, flooding, diversion of flow, damming, undermining, seepage, slumping or other adverse effects to the Works or surrounding areas and structures.

Equipment and material
Location: Clear of watercourses and secured so that they will not cause danger or damage in the event of large runoff flows. This is a WITNESS POINT.

4.3 ESTABLISHMENT
Set-out
Approval: Set out the work to the location and levels shown on the drawings prior to construction. Mark any proposed changes that may arise due to actual site conditions. This is a HOLD POINT.

4.4 EXCAVATION
Existing underground services
Excavation: Do not excavate by machine within 1 m of existing underground services.
Location: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, of locating underground pipe and cables (possible within two working days). See www.1100.com.au.
Public utility authorities: If public utilities exist in the vicinity of drainage works, obtain the approval of the relevant authority to the method of excavation before commencing excavation and submit. This is a HOLD POINT.

Safety
Stabilisation: Provide any shoring, sheet piling or other stabilisation of the sides of trench excavation necessary to conform with statutory requirements.

Blasting operation
Particle velocity: If excavation by blasting is permitted, ensure that the peak particle velocity measured on the ground adjacent to any previously installed drainage structure does not exceed 25 mm/sec. This is a WITNESS POINT.
Blasting operations generally: To 1112 Earthworks (Roadways).

Trenches
Method: Excavate trenches as follows:
- To the line, grade, width and depth shown on the drawings or as directed.
- Construct the bottom of the trench so that no localised ponding can occur.
- Remove all loose material.
Approval: Required for completed trenches prior to installation of drainage works. This is a HOLD POINT.

Unsuitable material
Definition: Material that does not conform with 1112 Earthworks (Roadways) as determined by the Superintendent.
Remedial actions:
- Remove and dispose of unsuitable material at the bottom of the trench or at foundation level.
- Replace with backfill material to conform with the requirements of this worksection.
- Trim the bottom of the excavated trench or foundation parallel with the specified level and slope of the work.

Excavated material
Generally: Reuse the excavated material in the construction of embankments, backfilling or spoiled to conform with 1112 Earthworks (Roadways).

Backfilling
Requirements: Backfill to the relevant subsurface drainage worksections.
Materials: As specified in this worksection and to 1112 Earthworks (Roadways).
4.5 OUTLET STRUCTURES

Discharge and salinity prevention
Subsurface drainage pipes: Connect discharge into gully pits or to outlet structures as shown on the drawings or as directed.
Salinity prevention: Discharge on the downhill side of the embankment or in the cut area so as to reduce the risk of recharge to the subsurface water table. This is a WITNESS POINT.

Outlets
Location intervals: 150 m maximum

Rodent proofing
Method: Secure outlets, including those discharging into gully pits, with galvanised wire netting to conform with the drawings.

Erosion control
Method: Locate the outlet so that erosion of the adjacent areas does not occur and/or protect the outlet by the placement of selected stone or approved similar treatment.
Locations: Provide marker posts to indicate the location and assist maintenance.

Outlet pipe
Type: Provide unslotted outlet pipes from curtain drains.
Levels: Ensure no point in an outlet pipe is higher than the pipe at the end of the curtain drain.

Concrete
Specification for outlet structures: Concrete to 0319 Minor concrete works.

4.6 RECORDING OF SUBSURFACE DRAINAGE INFORMATION

Work as executed plans
Record: Keep a detailed record of all subsurface drainage pipes. Provide work-as-executed plans showing completed subsurface drainage systems.

Information sheets
Submit: Provide a subsurface drainage information sheet or sheets at the completion of construction of each drain or drainage system. This is a HOLD POINT.
Content: Include the following:
- Date of completion of drain construction.
- Drain number.
- Type of drain.
- Pipe size.
- Pipe type.
- Filter type.
- Grade of drain.
- Locations of cleanouts.
- Locations of outlets.
- Geotextile:
  - Sheet: Yes/No.
  - Seamless tubular filter fabric: Yes/No.
- Response Time: The time taken for water to travel from the inlet end of a drain or from a cleanout leading to a drain to the outlet end of the drain.

4.7 LIMITS AND TOLERANCES

Application
Summary: The limits and tolerances applicable to this worksection are summarised in Summary of limits and tolerances table.

Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/ subclause</th>
</tr>
</thead>
</table>

© AUS-SPEC (Oct 12) 8 April 2015
<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/ subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Type A</td>
<td>Type A filter material table</td>
<td>Filter material</td>
</tr>
<tr>
<td>- Type B</td>
<td>Type B filter material table and Type B filter material variation table</td>
<td>Filter material</td>
</tr>
<tr>
<td>- Type C</td>
<td>Type C filter material table</td>
<td>Filter material</td>
</tr>
<tr>
<td>- Type D</td>
<td>Type D filter material table</td>
<td>Filter material</td>
</tr>
<tr>
<td>Geotextile</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Curtain Drains Water</td>
<td>&gt; 50 l/m²/s</td>
<td>Geotextile</td>
</tr>
<tr>
<td>Transmission</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation by Blasting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak particle velocity</td>
<td>≤ 25 mm/sec</td>
<td>Excavation</td>
</tr>
<tr>
<td>Outlets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacing</td>
<td>Max 150 m</td>
<td>Outlet structures for subsurface drainage pipes</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General
Payment made to the schedule of rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1171.1 to 1171.5 inclusive.
Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
- Erosion and sedimentation control measures: To conform with 1102 Control of erosion and sedimentation (Construction).
- Excavation and geotextile material: To conform with the worksection applicable to the particular activity.
- Removal of unsuitable material: To conform with 1112 Earthworks (Roadways).
- Concrete work for outlet structures: To conform with this worksection and not 0319 Minor concrete works.
- Miscellaneous minor concrete work not included in the pay items in this worksection: To conform with 0319 Minor concrete works.

5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1171.1 Filter material Type A backfill</td>
<td>- Compacted m³&lt;br&gt;- Calculate the volume from the actual length and depth of the trench or mat up to the level of the filter material multiplied by the design width of the trench.</td>
<td>- All costs associated with supply, placement and compaction of filter material and the capping of the trench where shown on the drawings.&lt;br&gt;- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| 1171.2 Filter material Type B backfill | Compacted m³ | - All costs associated with supply, placement and compaction of filter material and the capping of the trench where shown on the drawings.  
- The schedule quantity is a provisional quantity. |
| 1171.3 Filter material Type C backfill | Compacted m³ | - All costs associated with supply, placement and compaction of filter material.  
- The schedule rate is a provisional quantity. |
| 1171.4 Filter material Type D backfill | Compacted m³ | - All costs associated with the supply, placement and compaction of filter material.  
- The schedule quantity is a provisional quantity. |
| 1171.5 Outlet structures for subsurface drainage pipes | Each outlet structure.. | - Outlet structures in conformance with this worksection excluding outlets into pits.  
- All costs associated with the construction of the outlet including forming of the structure, supply of concrete and, where directed by the Superintendent, the provision of erosion control measures.  
- The schedule quantity is a provisional quantity. |
6 ANNEXURE A

6.1 SLOTTING DETAILS FOR THICK WALLED PVC PLASTIC PIPE

![Diagram of slotting details for thick walled PVC plastic pipe]

Diagram not to scale
Dimensions are in millimetres

Figure A1 Slotting details for thick walled PVC plastic pipe

6.2 PROCEDURE FOR FITTING SEAMLESS TUBULAR FILTER FABRIC TO SLOTTED PIPE

Procedure
Sequence: Seamless tubular filter fabric may be fitted to slotted pipe on site immediately before the slotted pipe is to be laid in its final position in the work.

General: Conform to the following procedure for fitting seamless tubular filter fabric to slotted pipe:
- Pull the filter fabric over and onto the 'mandrel'. The 'mandrel' is short length of smooth pipe of internal diameter 20 mm - 30 mm greater than the external diameter of the slotted pipe being enclosed by filter fabric.
- Pass the slotted pipe through the mandrel.
- When the end of the slotted pipe emerges from the mandrel, clamp the filter fabric to the forward end of the slotted pipe so that it cannot slip back along the pipe.
- Pull the remaining slotted pipe through the mandrel allowing the filter fabric to progressively slip and stretch fit over the slotted pipe as it emerges from the mandrel.
- After the slotted pipe has passed through the mandrel, cleanly cut the filter fabric leaving an overhang off the end of the pipe to allow for a fully covered join with an adjacent pipe when the pipes are installed in the drain.
- Clamp the filter fabric to the end of the slotted pipe to make sure the filter fabric remains stretch-fitted onto the pipe when the pipe is positioned in the drain.

**Precautions to be taken when using slotted pipe fitted with seamless tubular filter fabric**

**Protection:** Do not drag slotted pipe fitted with seamless tubular filter fabric over the ground. If carrying, lift slotted pipe fitted with seamless tubular filter fabric clear of the ground and protect from damage.

**Damaged seamless tubular filter fabric:** If the filter fabric is damaged and its filtering properties affected, remove from the pipe and replace with undamaged filter fabric.

**Loose seamless tubular filter fabric:** If, at any time during the installation, the filter fabric becomes loose on the slotted pipe re-stretch it to the correct position. If re-stretching causes any damage to the filter fabric, remove the damaged filter fabric from the pipe and replace with undamaged filter fabric.
1172 SUBSOIL AND FOUNDATION DRAINS

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide subsoil and foundation drains, as documented.

Performance
Requirements: Construct the works shown on the drawings or directed all in conformance with 0161 Quality (Construction).

Design
- design details and all the design parameters for the project design Designer: Suitably qualified to RP Eng/CP Eng standard to authorise design by signature.
Authority requirements: As required by the Conditions of Development Consent

1.2 CROSS REFERENCES

Worksections
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1171 Subsurface drainage.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used
AS 1289 Methods for testing soils for engineering purposes.
AS 1289.5.4.1 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio.
AS 1289.5.6.1 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material

Other publications
Note: Only the most current standards are to be usedAUSTROADS

1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- CI: Cast Iron.
- HDPE: High Density Polyethylene.

Definitions
General: For the purposes of this worksection the following definitions apply:
- Foundation drains: For drainage of seepage, springs and wet areas within and adjacent to the foundations.
- Panel drain: Corrugated flat plastic pipe.
- Selected material zone: The top part of the Upper zone of formation in which material of a specified higher quality is required.
- Subsoil drains: For drainage of ground water and/or the pavement in cuttings.
1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

Documents
Submit the following for approval:
- Filter materials: Refer to WITNESS POINTS.
- Calculations: Survey set out of works including quantity calculations.
- Components: Submit technical details of:
  . Geotextiles to 1171 Subsurface drainage.
  . Pipes and fittings to 1171 Subsurface drainage.
- Execution details: Refer to WITNESS POINTS.

1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subsoil / Foundation drains - Pipes</td>
<td>Submit bedding of compacted filter material laid to line and grade</td>
<td>3 working days before next activity</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Subsoil / Foundation drains - Excavation</td>
<td>Inspect excavation</td>
<td>1 working day prior to filling</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

WITNESS POINTS table – On-site activities

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATERIALS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Filter material</td>
<td>Type of filter material</td>
<td>3 working days before ordering material</td>
</tr>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Location</td>
<td>Mark location of drains consistent with drawings or directions</td>
<td>7 days prior to commencing works</td>
</tr>
<tr>
<td>Subsoil / Foundation drains - Pipes</td>
<td>Lay on compacted bed to documented line and level</td>
<td>1 working day before filling</td>
</tr>
<tr>
<td>Subsoil drains - Backfilling,</td>
<td>Backfilling to documented level and relative compaction</td>
<td>1 working days before covering with geotextile</td>
</tr>
<tr>
<td>Foundation drains - Backfilling</td>
<td>Backfilling to documented level and relative compaction</td>
<td>1 working days before covering with geotextile</td>
</tr>
<tr>
<td>Geotextile - Installation</td>
<td>Placement of fabric conformance</td>
<td>1 working day before filling</td>
</tr>
<tr>
<td>Geotextile - Installation</td>
<td>Ensure exposure periods are within the constraints</td>
<td>Progressive</td>
</tr>
<tr>
<td>Cleanouts – Field testing</td>
<td>Perform flushing test</td>
<td>3 working days from completion</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Programming the works
General: Program the works as follows:
- Plan sequence of activities.
- Address time and program sequence of HOLD POINTS and WITNESS POINTS.

3 MATERIALS

3.1 GENERAL

Filter material
Description: Type A or Type B filter material to 1171 Subsurface drainage capable of placing and compaction in the specific location and as shown on the drawings. Includes recycled crushed glass with a material size of 3mm - 6mm for use as a filter material which is in conformance with Table 2 of the 2010 GreenSpec. This is a WITNESS POINT.

Geotextiles and pipes
Conform to: 1171 Subsurface drainage.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Control of traffic: Conform to the following:
- Conform with workssection 1101 Control of traffic.
- Conform with Traffic Guidance Scheme in 1101 Control of traffic.

4.2 ESTABLISHMENT

Location
Layout: As shown on the drawings or as directed by the Superintendent. This is a WITNESS POINT.

Existing underground services
Excavation: Do not excavate by machine within 1 m of existing underground services.
Location: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, of locating underground pipe and cables (possible within two working days). See www.1100.com.au.

4.3 SUBSOIL DRAINS

Order of construction
Sequence: Construct subsoil drains as soon as possible after necessary earthworks are completed in the area of the drain.

Ground water: Where stabilisation of the subgrade is required, construct subsoil drains after completion of stabilisation except where excessive ground water is encountered, construct drain prior to stabilisation of the subgrade.

Excessive groundwater: Where a selected material zone is documented and excessive ground water is encountered, install subsoil drains in two stages as follows:
- Stage 1: Install standard subsoil drains below the base of the cutting prior to placement of select material in the selected material zone.
- Stage 2: Extend subsoil drain to top of the selected material zone after placement of selected material.

Excavation
Requirements: To 1171 Subsurface drainage.
Specified level: The bottom of the trench must not be more than 50 mm below the specified level of the invert of the pipe.
Smooth: Ensure the bottom and sides of the excavation are smooth with no protrusions that will damage the geotextile fabric.
Grade: Excavate the bottom of the trench to the same grade as the design pavement surface in the direction of the trench.
Minimum grade: If required increase the trench depth to provide a minimum grade of fall in the trench of 0.5%.
Prevent ponding: Excavate the bottom of the trench to prevent localised ponding of water occurs.
Over-excavation: If the trench is excavated below the documented level, backfill the trench to the documented level with non-porous subgrade material compacted to a relative compaction of at least 95% (Standard compaction) as determined by AS 1289.5.4.1.

Two stage construction: If a subsoil drain is constructed in two stages, carry out the excavation for Stage 2 after placement and compaction of the Selected Material Zone or the stabilised subgrade layer. Excavate the Stage 2 trench to the same line and width as the Stage 1 trench and to a depth to provide a clean, full contact with the filter material placed in Stage 1. Dispose of all excavated material to waste or incorporate into fills.

Inspection: To ensure the excavation conforms with the shape, grade line, filling and compaction and removal of any protrusions. This is a HOLD POINT.

**Pipes**

Bedding: 50 mm thick compacted filter material laid to the documented line and grade. This is a HOLD POINT.

Filter material type: As shown on the drawings or as directed by the Superintendent.

Pipe: Place centrally within the trench on the crushed aggregate the 100 mm diameter corrugated slotted plastic piping or corrugated flat plastic piping as shown on the drawings.

Tolerance: Deviation < 100 mm from the documented line. This is a WITNESS POINT.

Joints: Minimise joints in the pipeline.

Joint construction: Proprietary external joint coupling. Fit the inlet end of the pipe with a proprietary PVC cap.

**Backfilling**

Filter material: Backfill the trench with filter material to the documented level.

Layers: Place and compact the filter material in layers with a maximum compacted thickness of 300 mm. Tamp around and over the pipe to avoid damage or disturbance to the pipe.

Upper section of the trench: Backfill above the level documented for filter material backfill, with selected free draining backfill material, conforming to the requirements of 1112 Earthworks (Roadways).

Compaction: Compact cohesionless filter material to a Density Index of 70% determined by AS 1289.5.6.1 for the full depth of the backfill. This is a WITNESS POINT.

Two stage construction plug

Protection: Protect the filter material placed at the top of Stage 1 from scour and/or contamination by covering with a 50 mm thick plug of select fill material with a maximum particle size of 25 mm.

Compaction: Compact the select fill material to a relative compaction of 95% as determined by AS 1289.5.4.1.

Remove and replace: Remove this plug, any contaminated filter material and any select material covering, replace with filter material and compact to 95% relative compaction.

### 4.4 FOUNDATION DRAINS

#### Order of construction

Sequence: Construct foundation drains after completion of clearing and stripping operations, and before the commencement of embankment construction.

**Excavation and pipes**

Requirements: To 1171 Subsurface drainage and Subsoil drains.

**Backfilling**

Filter material: Backfill the trench with filter material to the documented level.

Layers: Place and compact the filter material in layers with a maximum compacted thickness of 300 mm. Tamp around and over the pipe to avoid damage or disturbance to the pipe.

Upper section of the trench: Backfill above the level documented for filter material backfill with suitable free draining backfill material.

Compaction: Compact cohesionless filter material to a Density Index of 70% determined by AS 1289.5.6.1 for the full depth of the backfill. This is a WITNESS POINT.

### 4.5 GEOTEXTILE

**Location**

Extent: As shown on the drawings or as directed by the Superintendent.
Location: At the interface between the filter material and adjoining materials.

Installation
Placement: Cover the bottom and sides of the trench with sufficient free fabric to wrap around the completed drain. Conform to the shape of the trench with minimal wrinkles, folds or air voids between fabric and trench, but not stretched on the soil. This is a WITNESS POINT.
Joints: Provide laps of 500 mm at joints in the fabric.
Program: Ensure the period between initial laying out and final cover of the geotextile with drainage backfill layer does not exceed 14 days. Where possible place geotextiles just ahead of construction works and cover with materials within 48 hours. This is a WITNESS POINT.
Damage: Take all reasonable care to ensure that the geotextile is not damaged during installation and backfilling operations.
Remove and replace: Any geotextile fabric exposed for longer than 14 days must be removed and replaced at no extra cost.

4.6 OUTLET STRUCTURES

Discharge and salinity prevention
Subsurface drainage pipes: Connect discharge into gully pits or to outlet structures as shown on the drawings or as directed.
Salinity prevention: Discharge on the downhill side of the embankment or in the cut area so as to reduce the risk of recharge to the subsurface water table. This is a WITNESS POINT.

Outlets
Location intervals: 150 m maximum.

Rodent proofing
Method: Secure outlets, including those discharging into gully pits, with galvanised wire netting to conform with the drawings.

Erosion control
Method: Locate the outlet so that erosion of the adjacent areas does not occur and/or protect the outlet by the placement of selected stone or approved similar treatment.
Locations: Provide marker posts to indicate the location and assist maintenance.

Outlet pipe
Type: Provide unsloped outlet pipes from curtain drains.
Levels: Ensure no point in an outlet pipe is higher than the pipe at the end of the curtain drain.

Concrete
Specification for outlet structures: Concrete to 0319 Minor concrete works.

4.7 CLEANOUTS

Location
Details: As shown on the drawings. Do not locate pits in unsealed shoulders, drain inverts or on batter faces.
Location: At the commencement of each run of subsoil drain line and at intervals of approximately 100 - 140 m to conform with AGPT10.

Type
Clean out: Supply the standard CI caps as shown on the drawings.

Field testing
Method: After completion of backfilling, pump clean water into the cleanout at the commencement of each run until only clean water discharges at the outlet.
Flushing: The minimum rate of flow of flushing water at the inlet must be 100 l/min. This is a WITNESS POINT.

4.8 MARKING OF DRAINS

Completion
Records: Keep a detailed record of all trench drain installations. Mark 'Work-as-Executed' drawings of the completed drainage system. Submit within 28 days of completion of the works.
Mark: Markings location and type to conform with the relevant State Road Authority and AGPT10-09.
Pegs: Treated or painted timber 75 mm diameter with 600 mm of post above ground level. Do not use the colour white.
ID plate: Attach an identification plate to the marker post or pit lid.

4.9 LIMITS AND TOLERANCES

The limits and tolerances applicable to this worksection are summarised in **Summary of limits and tolerances table**.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/ subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Trench Grade</td>
<td>≥ 0.5%</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>- Compaction</td>
<td>&gt; 95% (Standard compaction)</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>Laying of pipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment</td>
<td>Deviation &lt; 100 mm from the documented line at any point</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>Subsoil drain backfill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Layer thickness</td>
<td>300 mm max</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>- Compaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Filter material</td>
<td>70% Density Index for cohesionless material.</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>- Backfill material</td>
<td>100% (Standard compaction)</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>Outlet spacing</td>
<td>150 m max</td>
<td>Outlets</td>
</tr>
<tr>
<td>Cleanout spacing</td>
<td>100 - 140 m approx</td>
<td>Cleanouts</td>
</tr>
<tr>
<td>Foundation drain backfill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backfilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Layer thickness</td>
<td>300 mm max</td>
<td>Foundation drains</td>
</tr>
<tr>
<td>- Compaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Filter material</td>
<td>70% Density Index for cohesionless material.</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>- Backfill material</td>
<td>&gt; 95% (Standard compaction)</td>
<td>Foundation drains</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1172.1 to 1172.6 inclusive.
Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
- Filter material and outlet structures: To conform with 1171 Subsurface drainage.
- Backfill material (other than filter material): To conform with this worksection and not 1112 Earthworks (Roadways).
### 5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1172.1 Excavation for subsoil and foundation drains</td>
<td>m³</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Setting out and associated survey work.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Excavation of all types of material – separate rates for earth or rock are not acceptable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The sides of the trench are taken as vertical.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Replacement for over excavation for any reason.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Control of stormwater run-off, temporary drainage and erosion and sedimentation control.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The disposal of material from drain excavation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1172.2 Subsoil drain pipe—100 mm dia slotted corrugated plastic pipe</td>
<td>Linear metre</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply and laying of the subsoil pipe including connections, markers, fittings and seamless tubular filter fabric where documented.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1172.3 Subsoil drain pipe—corrugated flat plastic pipe</td>
<td>Linear metre</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply and laying of the subsoil pipe including connections, markers, fittings and seamless tubular filter fabric where documented.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1172.4 Supply, placement and compaction of backfill material (other than filter material) for subsoil and foundation drains</td>
<td>m³</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply, placement and compaction of documented material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule of quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1172.5 Supply and placement of geotextile</td>
<td>m²</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply, placement and securing of the geotextile material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- No additional payment for additional geotextile used in lap joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>1172.6 Cleanout structures</strong></td>
<td>Each</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td>Cleanout structure constructed in conformance with the drawings.</td>
<td>- Construction of cleanout structures including the supply and installation of standard cast iron lids and the recording of cleanout locations in conformance with 1171 Subsurface drainage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
</tbody>
</table>
1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide sub-pavement drains, intra-pavement drains and edge drains, as documented.

Performance
Requirements: Construct the works as documented or directed by the Superintendent.

Design
- design details and all the design parameters for the project
design
Designer: Suitably qualified to RP Eng/CP

Eng standard to authorise design by signature.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1141 Flexible pavement base and subbase.
- 1144 Asphaltic concrete (Roadways).
- 1171 Subsurface drainage.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:

Note: Only the most current standards are to be used

AS 1289 Methods of testing soils for engineering purposes
AS 1289.3.3.1 Soil classification tests—Calculation of the plasticity index of a soil
AS 1289.5.4.1 Soil compaction and density tests—Compaction control test—Dry density
ratio, moisture variation and moisture ratio
AS 1289.5.6.1 Soil compaction and density tests - Compaction control test - Density
index method for a cohesionless material

Other publications
Note: Only the most current standards are to be used

AUSTROADS
AGPT10 Guide to pavement technology Part 10 - Subsurface drainage

1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
Ci: Cast iron.
HDPE: High Density Polyethylene.

Definitions
General: For the purposes of this worksection the following definitions apply:
Edge drains: For drainage of rigid pavements.
Intra-pavement drains: For drainage of pavement layers of a flexible pavement where the subbase
material is a macadam crushed rock or open graded asphaltic concrete.
Panel drain: Corrugated flat plastic pipe.
Selected material zone: The top part of the Upper zone of formation in which material of a specified higher quality is required.

Sub-pavement drains: For drainage of the pavement layers where the subbase is not a macadam crushed rock.

RMS - Roads and Maritime Services.

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

Documents
Submit the following for approval:
- Filter materials: Refer to WITNESS POINTS.
- Components: Submit technical details of:
  . Geotextiles to 1171 Subsurface drainage.
  . Pipes and fittings to 1171 Subsurface drainage.
- Execution details: Proposals for timing and sequence of activities.
- Work as executed drawings.

1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-pavement drains -</td>
<td>Submit bedding of compacted filter material laid to line and grade</td>
<td>1 working day before</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Laying of pipe</td>
<td></td>
<td>covering</td>
<td></td>
</tr>
<tr>
<td>Intra-pavement drains</td>
<td>Provide certification that drain has adequate crushing strength</td>
<td>3 working days before</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Laying of pipe</td>
<td></td>
<td>ordering</td>
<td></td>
</tr>
<tr>
<td>Intra-pavement drains</td>
<td>Submit details of proposed method of securing pipes</td>
<td>7 days before pipe laying</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Laying of pipe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edge drains - Laying of</td>
<td>Submit details of proposed method of securing pipes</td>
<td>7 days before pipe laying</td>
<td>Superintendent</td>
</tr>
<tr>
<td>pipe</td>
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<td></td>
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</tbody>
</table>

WITNESS POINTS table

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>General - Filter material</td>
<td>General - Filter material</td>
<td>General - Filter material</td>
<td>General - Filter material</td>
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<td></td>
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</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment - Location</td>
<td>Mark location of drains consistent with drawings or directions</td>
<td>7 days prior to commencing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>works</td>
<td></td>
</tr>
<tr>
<td>Sub-pavement drains -</td>
<td>Laid to documented line and level</td>
<td>1 working prior to Backfilling</td>
<td></td>
</tr>
<tr>
<td>Laying of pipe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sub-pavement drains -</td>
<td>Backfill to documented level.</td>
<td>3 working days prior covering</td>
<td></td>
</tr>
<tr>
<td>Backfilling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edge drains - Excavation</td>
<td>Demonstrate proposal for strip filter if required.</td>
<td>3 working days</td>
<td></td>
</tr>
<tr>
<td>Edge drains - Laying of</td>
<td>Laid to documented line and</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>pipe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item/Clause title</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td>Release by</td>
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<td></td>
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</tr>
<tr>
<td>Clean outs – Field testing</td>
<td>Perform flushing test</td>
<td>3 working days from</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>completion</td>
<td></td>
</tr>
</tbody>
</table>

2  PRE-CONSTRUCTION PLANNING

2.1  SCHEDULING

Program of the works

Program the works as follows:
- Plan sequence of activities.
- Address time and program sequence of HOLD POINTS and WITNESS POINTS.

3  MATERIALS

3.1  GENERAL

Filter material and impervious material
Description: Conform to 1171 Subsurface drainage: Capable of placing and compaction and as shown on the drawings. This is a WITNESS POINT.

Geotextiles and pipes
General: Conform to 1171 Subsurface drainage.

4  EXECUTION

4.1  PROVISION FOR TRAFFIC

General
Control of traffic: Conform to the following:
- Conform with worksection 1101 Control of traffic.
- Conform with Traffic Guidance Scheme in 1101 Control of traffic.

4.2  ESTABLISHMENT

Location
Layout: Construct pavement drains as shown on the drawings and as directed. This is a WITNESS POINT.

Existing underground services
Excavation: Do not excavate by machine within 1 m of existing underground services.

Location: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, of locating underground pipe and cables (possible within two working days). See www.1100.com.au.

4.3  ORDER OF CONSTRUCTION

Sub-pavement drains
Sequence: Construct sub-pavement drains as soon as possible after earthworks are completed in the area of the drain.

Ground water: If stabilisation of the subgrade is required, construct the sub-pavement drain after completion of stabilisation except that where excessive ground water is encountered, construct sub-pavement drains prior to stabilisation of the subgrade.

Excessive groundwater: Where a Selected Material Zone is specified and excessive ground water is encountered, sub-pavement drains may be installed in two stages as follows:
- Stage 1: Standard sub-pavement drains installed below the base of the cutting prior to placement of select material in the Selected Material Zone.
- Stage 2: Extension of sub-pavement drain to top of the Selected Material Zone after placement of selected material.
Intra-pavement drains
Sequence: Construct intra-pavement drains after the completion of the layer below the crushed rock macadam or 40 mm open graded asphaltic concrete subbase and preceding the construction of the subsequent layers.

Edge drains
Sequence: Construct edge drains after the construction of the rigid pavement and before the placement and compaction of verge material.

4.4 SUB-PAVEMENT DRAINS

Excavation
Trench dimensions: Trim the trenches 300 mm wide to the required line and to a depth of 600 mm below the bottom of the subbase or below the base of the cutting where two stage construction of the sub-pavement drain is required.

Trench grade: Construct the bottom of the trench at the same grade as the design pavement surface except where the grade of the roadway is less than 0.5%, increase the depth of the trench to provide a grade of 0.5% in the trench. Excavate the bottom of the trench to prevent localised ponding of water.

Two-stage construction: If a subpavement drain is constructed in two stages, conform to the following:
- Carry out excavation for Stage 2 after placement and compaction of the Selected Material Zone.
- Excavate the Stage 2 trench to the same line and width as Stage 1 and to a depth to provide a clean, full contact with the filter material previously placed in Stage 1.

Disposal: Dispose of all excavated material to waste or incorporate into fills.

Laying of pipe
Bedding: 50 mm thick compacted filter material laid to the documented line and grade. This is a HOLD POINT.

Filter material type: As shown on the drawings or as directed.
Pipe: 100 mm diameter corrugated slotted plastic piping or the corrugated flat plastic panel drain on the compacted bed as shown on the drawings.
Tolerance: Deviation < 100 mm from the documented line. This is a WITNESS POINT.

Joints: Minimise joints in the pipeline.

Joint construction: Proprietary external joint coupling. Fit the inlet end of the pipe with a proprietary PVC cap.

Backfilling
Filter material: Backfill the trench with filter material to the documented level. This is a WITNESS POINT.

Layers: Place and compact the filter material in layers with a maximum compacted thickness of 300 mm. Tamp around and over the pipe to avoid damage or disturbance to the pipe.

Compaction: Compact cohesionless material to a Density Index of 70% determined by AS 1289.5.6.1 for the full depth of the backfill.

Pipe outlets:
- Backfill the trench on the outlet section of pipes discharging through the fill batters with the nominated filter material to a depth of 50 mm above the pipe.
- Backfill the balance of trench with earth backfill material of maximum particle size of 50 mm and compact for the full depth to a relative compaction of 95% (Standard compaction) to AS 1289.5.4.1.

Temporary plug over filter material
Requirement: In the case of sub-pavement drains of two stage construction, when it is not practical to place the pavement layers or the Selected Material Zone immediately after the construction of Stage 1.

Method: Protect the filter material placed to the top of Stage 1 from scour and/or contamination by covering with a 50 mm thick plug of compacted select fill material having a maximum particle size of 25 mm and Plasticity Index of not more than 12 as determined by AS 1289.3.3.1.

Removal: Remove this plug, any contaminated filter material and any select material covering and replace with the nominated filter material and compact immediately ahead of the placement of the pavement layer. Dispose of all excavated material to waste or incorporate in fills.
4.5 INTRA-PAVEMENT DRAINS

Excavation
Trench dimensions: Cut a "V" shaped trench approximately 75 mm deep to the required line in the pavement layer immediately below the crushed rock macadam pavement layer. No excavation is required below a 40 mm open graded asphaltic concrete subbase layer.
Trench grade: Construct the bottom of the trench at the same grade as the roadway and ensure localised ponding of water does not occur.
Discharge pipe: If the pipe is to discharge through the fill batter, construct a trench on a grade suitable for the pipe to discharge its contents without scour. After laying the pipe, backfill the trench with fill material and compact for the full depth to a relative compaction of not less than 95% (Standard compaction) as determined by AS 1289.5.4.1.
UPVC pressure pipe: Provide thick walled slotted unplasticised PVC pressure pipe, to conform with 1171 Subsurface drainage, with the following:
- Crushed rock subbases having not more than 10% of material passing the 9.5 mm Australian Standard sieve and having layer thicknesses neither less than 150 mm nor more than 200 mm.
- Open graded asphalt subbases having layer thicknesses neither less than 80 mm nor greater than 100 mm.
Suitability for subbases: If the subbase requires pavement drains, provide certification that the proposed type of pavement drain has adequate crushing strength in the following locations: This is a HOLD POINT.
- Crushed rock subbase: Depth > 200 mm.
- Asphalt subbase: Depth > 100 mm.
Inlet cap: The inlet end of the pipe to be fitted with a cap to conform with 1171 Subsurface drainage.
Outlet length: Provide unslotted outlet pipe from the outside edge of the free-draining subbase to an outlet structure in the embankment batter and seal the pipe joints in this length of pipe with suitable couplings or mastic.
Level and alignment: Lay the pipe to the specified line and level.
Deviation: Not to deviate the pipe from the specified line by more than 100 mm at any point.
Pipe anchorage: Anchor the pipes by securing all pipes held to the layer under the free-draining subbase to prevent movement of the pipes during placement and compaction of the free-draining subbase.
Anchorage alternatives: Submit details of the proposed method of securing the pipes to the layer under the free-draining subbase. This is a HOLD POINT.
Alternative securing method: If the approved method of securing the pipes to the layer under the free draining subbase allows movement of the pipes, discontinue the method and submit an alternative securing method for approval.

Backfilling
Subbase: Spread subbase material, compact and trim, where appropriate, as follows:
- For crushed rock macadam subbase: To 1141 Flexible pavement base and subbase.
- For open graded asphalt subbase: To 1144 Asphaltic concrete (Roadways).
Prevent damage to pipes: Place, spread and compact the subbase without damage to the intra-pavement drain pipes.
Remove and replace: If any pipes are damaged remove and replace the damaged pipes.
Layers: Place and compact the filter material in layers with a maximum compacted thickness of 300 mm. Tamp around and over the pipe to avoid damage or disturbance to the pipe.
Compaction: Compact cohesionless material to a Density Index of 70% determined by AS 1289.5.6.1 for the full depth of the backfill

4.6 EDGE DRAINS

Excavation
Trench dimensions: Trim the verge material to subgrade level and to the minimum width shown on the drawings.
Trench grade: Construct the bottom of the trench at the same grade as the roadway and ensure localised ponding of water does not occur. Where the grade of the roadway is less than 0.5% excavate the trench to provide a minimum grade of 0.5%.

Discharge pipe: If the pipe is to discharge through the fill batter excavate a suitable trench to provide the required grade.

Strip filters: Do not use strip filters unless fully demonstrated and approved. This is a WITNESS POINT.

Laying of pipe
Slotted corrugated plastic pipe: Provide 65 mm diameter slotted corrugated plastic pipe enclosed in seamless tubular filter fabric to conform with 1171 Subsurface drainage, for edge drains unless shown otherwise on the drawings or as directed.

Slotted PVC pressure pipe: If any part of a shoulder consists of material other than concrete, install slotted thick walled PVC pressure pipe.

Securely hold in place: Secure all pipes held against the vertical face of the rigid pavement.

Approval for method of securing pipes: Submit details of the proposed method of securing the pipes against the rigid pavement. This is a HOLD POINT.

Bedding and alignment: Lay the pipe on a prepared bed to the documented line and level.

Tolerance: Deviation < 100 mm from the documented line at any point. This is a WITNESS POINT.

Joints: Minimise joints in the pipeline.

Joint construction: Proprietary external joint coupling. Fit the inlet end of the pipe with a PVC cap.

Backfilling
Filter material: Cover the pipe with Type B filter material to 1171 Subsurface drainage and as shown on the drawings.

Soaking of filter material: Mechanical compaction of this filter material is not required. Soak with water after placement of the filter material. Soak and add additional filter material as required to provide the final dimensions shown on the drawings.

Material: Backfill material to 1112 Earthworks (Roadways) and as required for verges. Avoid damage or disturbance of the pipe.

Compaction: Relative compaction of not less than 100% (Standard compaction) to AS 1289.5.4.1.

4.7 OUTLETS

General
Requirements and specification of outlet structures: Conform to 1171 Subsurface drainage.

Intra-pavement drain discharge: If discharge must be constructed extend each pipe using a 60° bend and unslotted pipe to discharge through the fill batter and construct an outlet structure on the discharge end to conform with the drawings.

Edge drain: If discharge must be constructed provide unslotted pipe with a mastic sealed joint from the outlet section of a pipe at the vertical face of the rigid pavement to an outlet in the embankment batter.

Rodent proofing
Method: Secure outlets, including those discharging into gully pits, with galvanised wire netting to conform with the drawings.

4.8 CLEANOUTS

Location
Details: As shown on the drawings. Do not locate pits in unsealed shoulders, drain inverts or on batter faces.

Location: At the commencement of each run of subsoil drain line and at intervals of approximately 100 - 140 m to conform with AGPT10-09.

Type
Clean out: Supply the standard CI caps as shown on the drawings.

Field testing
Method: After completion of backfilling, pump clean water into the cleanout at the commencement of each run until only clean water discharges at the outlet.
Flushing: The minimum rate of flow of flushing water at the inlet must be 100 l/min. This is a **WITNESS POINT**.

### 4.9 MARKING OF DRAINS

**Completion**

Records: Keep a detailed record of all trench drain installations. Mark "Work-as-Executed" drawings of the completed drainage system. Submit within 28 days of completion of the works.

Mark: Markings location and type to conform with Roads and Maritime Services (RMS) specifications and AGPT10-09.

Pegs: Treated or painted timber 75 mm diameter with 600 mm of post above ground level. Do not use the colour white.

ID plate: Attach an identification plate to the marker post or pit lid.

### 4.10 LIMITS AND TOLERANCES

**Application**

Summary: The limits and tolerances applicable to this worksection are summarised in **Summary of limits and tolerances table**.

#### Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excavation Trench Grade</td>
<td>≥ 0.5%</td>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>Sub-pavement drain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laying of pipe</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment</td>
<td>Deviation &lt; 100 mm from the documented line at any point.</td>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>Backfill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer thickness</td>
<td>300 mm max</td>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>Compaction (Relative)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Filter material</td>
<td>100% (Standard compaction)</td>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>- Backfill material</td>
<td>&gt; 95% (Standard compaction)</td>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>Cleanout spacing</td>
<td>100 - 140 m approx</td>
<td>Cleanouts</td>
</tr>
<tr>
<td>Outlet spacing</td>
<td>150 m max</td>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intra-pavement drains</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Edge drains</td>
</tr>
<tr>
<td>Intra-pavement drain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backfill</td>
<td>&gt; 95% (Standard compaction)</td>
<td>Intra-pavement drains</td>
</tr>
<tr>
<td>Alignment</td>
<td>Deviation &lt; 100 mm from specified line at any point.</td>
<td>Intra-pavement drains</td>
</tr>
<tr>
<td>Edge drains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment</td>
<td>Deviation &lt; 100 mm from specified line at any point.</td>
<td>Edge drains</td>
</tr>
<tr>
<td>Compaction (relative)</td>
<td>100% (Standard compaction)</td>
<td></td>
</tr>
</tbody>
</table>

#### 5 MEASUREMENT AND PAYMENT

**Note:** This item is an Optional condition for Development. Required for Council Project.

### 5.1 MEASUREMENT

**General**

Payment made to the schedule of rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1171.1 to 1171.5 inclusive.

Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

**Methodology**
The following methodology will be applied for measurement and payment:
- Filter material and outlet structures: To conform with 1171 Subsurface drainage.
- Subbase material, including spreading, compacting and trimming: To conform with either 1141 Flexible pavement base and subbase or 1144 Asphalitic concrete (Roadways), as appropriate.
- Selected material backfill to edge drains: To conform with 1112 Earthworks (Roadways).

### 5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1173.1 Excavation</td>
<td>m³</td>
<td>All costs associated with the following:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Setting out and associated survey work.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Excavation for all types of material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Separate rates for earth or rock are not acceptable.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Replacement for overexcavation for any reason.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Control of stormwater run-off, temporary drainage and erosion and sedimentation control.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Disposal of excavation material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1173.2 Subsoil drain pipe</td>
<td>Linear metre</td>
<td>All costs associated with the following:</td>
</tr>
<tr>
<td>- 1173.2(1) 100 mm dia slotted corrugated plastic pipe.</td>
<td></td>
<td>- Supply, laying and securing of the subsoil pipe, including connections, fittings and seamless tubular filter fabric where specified.</td>
</tr>
<tr>
<td>- 1173.2(2) 58 mm dia thick walled unplasticised PVC pressure pipe.</td>
<td></td>
<td>The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>- 1173.2(3) 65 mm dia slotted corrugated plastic pipe.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1173.3 Cleanout structures</td>
<td>Each</td>
<td>All costs associated with the following:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Provision of cleanout structures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply and installation of lids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Recording of cleanout locations in accordance with 1171 Subsurface drainage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The schedule quantity is a provisional quantity.</td>
</tr>
</tbody>
</table>
1174 DRAINAGE MATS

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide drainage mats, filter materials and pipes as shown on the drawings, as documented.

Performance
Requirements: Conform with this specification, the Drawings and as directed by the Superintendent.

Design
- design details and all the design parameters for the project
designer: suitably qualified to RP Eng/CP
Eng standard to authorise design by signature.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.
- 1171 Subsurface drainage.
- 1173 Pavement drains.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:

Note: Only the most current standards are to be used

AS 1289 Methods of testing soils for engineering purposes.
AS 1289.5.6.1 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material

1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:

- Type A mats: Mats intended to ensure continuity of a sheet flow of water under fills, to collect surface seepage from a wet seepage area or for protection of vegetation or habitat downstream of the road reserve where a fill would otherwise cut the flow of water.

- Type B mats: Mats constructed to intercept water which would otherwise enter pavements by capillary action or by other means on fills and to intercept and control seepage water and springs in the floors of cuttings.


1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.

Components
General: Geotextiles and pipes to 1171 Subsurface drainage.

Materials
General: Refer materials clauses for items to 1171 Subsurface drainage.
1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A mats / Type B mats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geotextile, Damaged geotextile</td>
<td>Approval of condition or repair of geotextile</td>
<td>1 working day before next activity</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Filter material, Thickness</td>
<td>Approval of thickness and layers of filter material</td>
<td>3 working days before placing filters</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

WITNESS POINTS table

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type A mats / Type B mats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter material, Protective layer</td>
<td>Inspection of placement of protective layer over mat extension.</td>
<td>3 working days before placing materials</td>
</tr>
<tr>
<td>Discharge, Outlets</td>
<td>Inspection of outlet proposals</td>
<td>7 days before set-out of layers</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Programming the works
Program: To conform with embankment and pavement construction as follows:
- Type A mats: After the site has been cleared and grubbed and before commencement of embankment construction.
- Type B mats: After completion of the subgrade construction and before construction of the pavement.

3 MATERIALS

3.1 FILTER MATERIAL

Mat components
General: Conform to the following:
- Type A mats: Type B, C or D filter material to 1171 Subsurface drainage.
- Type B mats: Type A or D filter material to 1171 Subsurface drainage.

3.2 GEOTEXTILE

General
Geotextile: To 1171 Subsurface drainage.

3.3 PVC PRESSURE PIPE

General
Thick walled un-plasticised PVC pressure pipe: To 1171 Subsurface drainage.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Control of traffic: Conform to the following:
- Conform with worksection 1101 Control of traffic.
- Conform with Traffic Guidance Scheme in 1101 Control of traffic.

4.2 TYPE A MATS

Placement
Location: Conform to the following:
- Under embankments as shown on the drawings or as directed by the Superintendent.
- Extending 2 m beyond the toes of embankments.

Geotextile
General: Provide geotextile as follows:
- On the embankment foundation after the embankment foundation has been trimmed and any necessary trench drains installed.
- On top of and around the sides of the filter material after placement and compaction of the filter material to cover and enclose the sides of the drainage mat and filter material.

Geotextile under rock facing: Place an additional layer of geotextile on the drainage mat under the base of rock facing forming part of the embankment construction. Extend the additional layer of geotextile beyond the outside and inside faces of the bottom layer of rock.

Lap width: 500 mm minimum at each join in the geotextile.

Protection of geotextile: Secure the geotextile to prevent movement by wind or by construction plant placing subsequent layers of filter material or earth filling over the drainage mat. Protect from damage during construction of the drainage mat and during placement of subsequent layers of filter material, earth filling or rock facing.

Damaged geotextile: Replace or repair damaged geotextile. This is a HOLD POINT.

Filter material
Type: Type B, C or D as shown on the drawings or as determined by the Superintendent.
Location: Compacted on the geotextile.

Thickness: Conform to the following: This is a HOLD POINT.
- Known expected consolidation of embankment: 300 mm minimum plus allowance for the expected total consolidation of the embankment.
- Unknown expected total consolidation of the embankment foundation: 500 mm minimum.
- Layers: Provide filter material in two or more layers so that the thickness of a compacted layer is 250 mm maximum.

Protective layer: Cover the extension of the mat beyond the toe of the embankment with 300 mm filter material immediately after completion of construction of each drainage mat. This is a WITNESS POINT.

Discharge
Outlets: May be either of the following: This is a WITNESS POINT.
- Surface outlets at the toes of embankments.
- Piped outlets connected to other drainage systems conforming to 1171 Subsurface drainage.

4.3 TYPE B MATS

Placement
Location: In cuttings as shown on the drawings or as directed by the Superintendent.
Width: The full width of cuttings and for the pavement width in other locations.

Geotextile
General: Provide geotextile as follows:
- On the subgrade after the subgrade material has been compacted and trimmed.
- On top of and around the sides of the filter material so that the filter material is completely enclosed after completion of placement and compaction of the filter material.

Lap width: 500 mm minimum at each join in the geotextile.

Protection of geotextile: Conform to the following:
- General: Secure the geotextile to prevent movement by wind or by construction plant placing subsequent layers of filter material or earth filling over the drainage mat. Protect from damage
during construction of the drainage mat and during placement of subsequent layers of filter material, earth filling or rock facing.

- Damaged geotextile: Replace or repair damaged geotextile. This is a HOLD POINT.

UPVC pressure pipe: Lay thick walled unplasticised PVC pressure pipe on the geotextile at a distance of 200 mm from and parallel to the longitudinal edges of the drainage blanket as shown in the drawings.

Filter material
Type: Type A or D as shown on the drawings and as determined by the Superintendent.
Compaction: Compact cohesionless material to a Density Index of 70% determined by AS 1289.5.6.1.
Thickness: Conform to the following:
- As shown on the drawings or as directed by the Superintendent. This is a HOLD POINT.
- Layers: Provide filter material in layers so that the thickness of a compacted layer is 250 mm maximum. This is a WITNESS POINT.

Discharge
Outlets: To 1171 Subsurface drainage. This is a WITNESS POINT.

Tolerance
Surface level: At the design level for the top of the drainage mat with a tolerance of + 0 and - 40 mm.

4.4 LIMITS AND TOLERANCES

Application
Summary: The limits and tolerances applicable to this worksection are summarised in Summary of limits and tolerances table.

Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Clause/ subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filter material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer thickness</td>
<td>250 mm max</td>
<td>Type A mats &amp; Type B mats</td>
</tr>
<tr>
<td>Compaction (Relative) Type A filter material</td>
<td>100% (Standard compaction)</td>
<td>Type B mats</td>
</tr>
<tr>
<td>Type B mats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design level at top of mat</td>
<td>+ 0, - 40 mm</td>
<td>Type B mats</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General
Payment made to the schedule of rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1171.1 to 1171.5 inclusive.
Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
- Filter material and outlet structures are measured and paid to conform with 1171 Subsurface drainage.
- Thick walled unplasticised PVC pressure pipe is measured and paid to conform with this worksection and not 1173 Pavement drains or 1171 Subsurface drainage.
### 5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1174.1 Supply and placement of geotextile</strong></td>
<td>m² of area covered</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Area covered by geotextile measured on site, excluding additional geotextile used in lap joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- For Type A drainage mats, the additional layer of geotextile placed under rock facing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- All costs associated with supply, placing and securing of the geotextile material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td><strong>1174.2 Drainage mat outlet pipe</strong></td>
<td></td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td>- The linear metre of pipe laid</td>
<td>- All costs associated with the supply and laying of the pipe.</td>
</tr>
<tr>
<td></td>
<td>Actual length laid will be measured along the centreline of the pipe including pipe leading to outlet structures.</td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
</tbody>
</table>
1191 PAVEMENT MARKINGS

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide pavement markings, as documented.

Performance
Requirements: Conform with this worksection, 0161 Quality (Construction), the drawings, specifications and directions by the Superintendent, consistent with requirements and appropriate NSW legislation.

Requirements: Thermoplastic linemarking on all AC works, painted linemarking on bitumen seals. As required by the Conditions of Development Consent to Road and Maritime Services (RMS) Specifications.

Design
- design details and all the design parameters for the project design
- Engineer to RP Eng or CP Eng standard to authorise design by signature.

NOTE. In Great Lakes Council Thermoplastic linemarking to be utilised on asphalt wearing surfaces, with paint utilised for infill on asphalt wearing surfaces only and paint linemarking on bitumen seals. Refer to Conditions of Development Consent and Construction Certificate.

Authority requirements: This worksection does not override any applicable NSW or Local Government legislation and is to be read in conjunction with AS 1742.3 and the Roads and Maritime Services (NSW) RMS QA Specification DCM R141 Pavement Marking.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:

Note: Only the most current standards are to be used

AS 1289 Methods of testing soils for engineering purposes
AS 1289.2.1.4 Soil moisture content tests - Determination of the moisture content of a soil - Microwave-oven drying method (subsidary method)
AS 1580 Paints and related materials-Methods of test
AS/NZS 1580.107.3 Determination of wet film thickness by gauge
AS/NZS 1580.401.8 No-pick-up time of road marking paints
AS 1742 Manual of uniform traffic control devices
AS 1742.2 Traffic control devices for general use
AS 1742.3 Traffic control devices for works on roads
AS 1906 Retroreflective materials and devices for road traffic control purposes
AS 1906.3 Raised pavement markers (retroreflective and non-retroreflective)
AS/NZS 2009 Glass beads for pavement-marking materials
AS 2700 Colour Standards for general purposes
AS 4049 Paints and related materials-Pavement marking materials
AS 4049.1 Solvent-borne paint - For use with surface applied glass beads
AS 4049.2 Thermoplastic pavement marking materials - For use with surface applied glass beads
AS 4049.3 Waterborne paint— For use with surface applied glass beads
ASTM D3335  Standard test method for low concentrations of lead, cadmium, and cobalt in paint by atomic absorption spectroscopy

Other publications
Roads and Maritime Services (NSW)
RMS Delineation manual 2008 Section 1 to 5
RMS Test method T841 2001 Field measurement of film thickness of road marking paint
RMS QA Specification DCM R141 Pavement Marking 2011

1.4 STANDARD

General
Pavement markings: To AS 1742.2, & RMS R141.

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the definitions given below apply:
- Paint: In this worksection implies ‘pavement marking paint’.
- Thermoplastic material: In this worksection implies ‘thermoplastic pavement marking material’.

Definitions
General: For the purposes of this worksection the definitions given below apply:
- Longitudinal linemarking: All lines that are generally parallel to the traffic flow, such as centre, lane, edge, turn, continuity and transition lines and outline markings.
- Other markings: All diagonal and chevron markings on the pavement symbols, words, numerals and arrows, kerb markings and markings for parking.
- Pavement marking: All longitudinal linemarking, transverse lines, raised pavement markers and other markings placed on the road to control traffic movement or parking.
- Transverse lines: All lines that are marked at right angles to the general traffic flow, such as Stop/Give way lines and pedestrian crosswalk lines.
- RMS- Roads and Maritime Services.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.
Requirement: Conform to the drawings, specified procedures and Standards.
Approvals: Submit NATA Certificates, conform to HOLD POINTS, WITNESS POINTS

Documents
Submit the following for approval:
- Proposed supplier.
- Materials and components: Submit Certification of materials as specified.
- Execution details: Refer to HOLD POINTS, WITNESS POINTS.
- Submit details of set-out.
  - Field testing for thermoplastics and CAP.

1.7 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause title/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificate of compliance – Material quality</td>
<td>Submit NATA Test Reports on materials</td>
<td>7 days before work is scheduled to commence</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Establishment</td>
<td>Approval for surface</td>
<td>7 days before</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Surface preparation</td>
<td>preparation required</td>
<td>commencement of activity</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------</td>
<td>--------------------------</td>
<td></td>
</tr>
<tr>
<td>Establishment - Surface preparation</td>
<td>Superintendent direction on suspension of work</td>
<td>Progressive</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Removal of redundant markings - Removal method</td>
<td>Submit method for approval</td>
<td>1 working day before commencement of activity</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

WITNESS POINTS table – On-site activities

<table>
<thead>
<tr>
<th>Clause title/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint marking - Application of paint and beads</td>
<td>Application of paint and beads to be checked for quality</td>
<td>Progressive</td>
</tr>
<tr>
<td>Thermoplastic marking – Field testing</td>
<td>Application of paint and beads to be checked for quality</td>
<td>Progressive</td>
</tr>
<tr>
<td>Raised pavement markers – Installation</td>
<td>Application of paint and beads to be checked for quality</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Program for the works
Requirements: Program the works to ensure adequate resources for the following:

- Provide planning resources to collate the technical requirements for materials consistent with Authority's legislation/standards.
- Engage NATA Laboratory for material certification.
- Plan the Setting Out and Control of Traffic Activities.
- Program the work to meet the constraints of HOLD POINTS, WITNESS POINTS.

2.2 CERTIFICATES OF COMPLIANCE

Material quality
Test reports: Submit, to the Superintendent, NATA Registered Laboratory Test Reports on the quality of the materials, including paint, glass beads, raised pavement markers and thermoplastic material proposed for use. Provide only materials conforming to the requirements of the referenced worksections/standards. Testing must be within 36 months of the products use for validity. This is a HOLD POINT.

3 MATERIALS

3.1 PAVEMENT MARKING PAINT

Type
Waterborne paint: To AS 4049.3.
Type: Do not use Solvent-borne paint.

3.2 QUARTZ FOR NON-SKID PAVEMENT MARKINGS

Quality
Transverse markings: Incorporate quartz as follows:
- Clean, sound, hard, durable, non-plastic and free from adherent coatings and any other foreign matter.
- When placed in a cylindrical container of minimum diameter 50 mm and minimum depth of 20 mm with the surface scribed off.
- Moisture content of less than 5% when tested to conform with AS 1289.2.1.4.
Particle size distribution: To the Particle size distribution table.

<table>
<thead>
<tr>
<th>Sieve mesh size (μm)</th>
<th>% Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>425</td>
<td>100</td>
</tr>
<tr>
<td>300</td>
<td>50-90</td>
</tr>
<tr>
<td>150</td>
<td>25-55</td>
</tr>
<tr>
<td>75</td>
<td>0-30</td>
</tr>
</tbody>
</table>

Transport: Package quartz to prevent damage during transportation and handling, and ensure that contamination does not occur.

3.3 THERMOPLASTIC MATERIAL

Standard
Thermoplastic marking: To AS 4049.2.

Non-profile thermoplastic pavement marking material
Sprayed or extruded thermoplastics: Generally used for longitudinal line marking and must be applied uniformly.

Screeded or preformed thermoplastic: Generally used for transverse lines and other markings.

3.4 RESERVED

3.5 REFLECTIVE GLASS BEADS

Quality
Standard: To AS/NZS 2009.

Glass bead proportion: Incorporate glass beads in thermoplastic material as follows:
- In the proportion of a minimum 20% of the total mass.
- As part of the aggregate constituent and to conform to the requirements of AS/NZS 2009.

Glass beads: Conform to the following:
- Type B 'Drop-on beads' or type D 'wet weather beads'.
- Supply type D wet weather beads intended for use with thermoplastic applications with a proprietary adhesive coating and clearly labelled on the packaging.

3.6 PAVEMENT MARKING TAPE

Type
Temporary markings: Strippable tape approved by the Superintendent.
Permanent pavement marking tape: Must be approved by the Superintendent.

3.7 RAISED PAVEMENT MARKERS

Type
Markers: Reflective and non-reflective markers to AS 1906.3 and the dimensions shown on the drawings.
Adhesive to wearing surface: Hot melt bitumen adhesive or an equivalent product approved by the Superintendent.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 ESTABLISHMENT

Colour
All pavement marking materials: White Y35 to AS 2700 with a luminance factor > 80% to AS 4049.3 unless otherwise specified.
Quartz: White, equivalent to or whiter than Y35, Off White to AS 2700 unless otherwise specified.

**Setting out**
Locations: Place all markings to conform with drawings, schedules or as directed.

**Surface preparation**
Clean dry surface: Apply pavement markings only to clean dry surfaces. Clean the surface to ensure a satisfactory bond between the markings and wearing surface of the pavement.
Existing material: If the existing surface is flaking or chipping, or in a condition where adhesion of the new material to the road surface cannot be guaranteed for the required life of the marking. Approval required for the extent and type of surface preparation required. This is a **HOLD POINT**.
Curing compound: If a curing compound has been applied, remove by physical abrasive means.
Wet weather: Do not carry out the pavement marking during wet weather or, if in the opinion of the Superintendent, rain is likely to fall during the process (unless otherwise directed). This is a **HOLD POINT**.
Concrete wearing surface: Lightly scabble the full area under each raised pavement marker to remove fine mortar material (laitance).

**Provision for traffic and protection of work**
Traffic: Provide for traffic, to conform with 1101 Control of traffic, while undertaking the work.
Protection: Protect the pavement markings until the material has hardened sufficiently so that traffic will not cause damage.

**Maintenance of pavement markings**
Responsibility: Born by the Developer/ Council Contractor for the maintenance, and replacement if necessary, of raised pavement markers and for all pavement marking during the construction period and the defects liability period.

### 4.3 PAINT MARKING

**Mixing of paint**
Requirement: Thoroughly mix all paint in its original container before use to produce a smooth uniform product consistent with the freshly manufactured product.

**Application of paint and beads**
Paint thickness: Apply uniformly and at the minimum dry film thickness as follows:
- Type B beads: 0.20 mm
- Type D beads: 0.30 mm. This is a **WITNESS POINT**.

**Longitudinal lines**
General: Conform to the following:
- Spray all longitudinal lines by an approved self propelled machine.
- Spray the two sets of lines forming a one-way or two-way barrier line pattern concurrently (unless otherwise directed by the superintendent).

Tolerances:
- Setting out: No more than 50 mm from the locations shown on the Drawings.
- Lengths: To any applicable local or state requirements and not vary by more than ± 50 mm.
- Widths: ± 5 mm.
- Gap between double lines: ± 10 mm.
- Beads for Longitudinal Lines: Conform to the following:
  - Apply Type B glass beads to the surface of all longitudinal lines at a minimum application rate of 0.50 kg/m² immediately after the application of the paint.
  - Set the actual application rate to overcome any loss of beads between the bead dispenser and the sprayed line.

**Transverse lines**
Tolerances:
- Setting out: No more than 50 mm from the locations shown on the drawings.
- Widths: ± 10 mm.
- Lengths: ± 10 mm.
Other markings
Dimensions: Conform to any applicable local or state requirements for the following:
- Arrows.
- Chevrons.
- Painted medians.
- Painted left turn islands.
- Speed markings.
Tolerance: Each dimension ± 50 mm.
Arrows and speed markings: Place square with the centreline of the traffic lane.
Hand spraying: Hand spraying with the use of templates (where necessary) to control the pattern and shape is to be permitted for transverse lines, symbols, legends, arrows and chevrons.
Beads for other markings:
- Type B glass beads to be similarly applied to all other paint markings at a minimum application rate of 0.30 kg/m² immediately after application of the paint by a method approved by the Superintendent.
- Type D glass beads to be similarly applied to all other markings at a minimum application rate off 0.5 kg/m².
Pavement marking appearance: Straight or with smooth, even curves where applicable. All edges to have a clean, sharp cut off.
Faulty application: Remove any marking material applied beyond the defined edge of the marking and leave a neat and smooth marking on the wearing surface of the pavement.
Field tests
Wet film thickness: To AS/NZS 1580.107.3 Method B, comb gauge.
Beads application: Check the application rate of glass beads by the method described in Annexure A.

4.4 QUARTZ APPLICATION
Anti-Skid material
Minimum application rate: To the Application rate for quartz table.
Surface application: Apply the quartz prior to the application of glass beads.

Application rate for quartz table

<table>
<thead>
<tr>
<th>Material</th>
<th>Transverse Lines</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.4 – 0.7 white crushed quartz</td>
<td></td>
</tr>
<tr>
<td>-If stirred into the paint prior to application</td>
<td>&gt; 500 g/litre</td>
</tr>
<tr>
<td>-If applied</td>
<td>&gt; 200 g/m²</td>
</tr>
</tbody>
</table>

4.5 THERMOPLASTIC MARKING
Preparation of thermoplastic material on site
Heating: Immediately before application, uniformly heat the thermoplastic material in a suitable kettle to the temperature recommended by the manufacturer, without overheating.
Molten pot life: No more than six hours for hydrocarbon resins and four hours for wood and gum resins.
Rejection: Should over-heating occur and/or the time expire for molten materials, discard the thermoplastic material.
Tack coat
Requirement: If the wearing surface of the pavement is smooth or polished.
Application: In conformance with the recommendations of the thermoplastic manufacturer.
Timing: Immediately before the application of the thermoplastic material.
Longitudinal lines
General: Conform to the following:
- Spray all longitudinal lines (or extruded in the case of profiled markings) by a self propelled machine approved by the Superintendent.
- Spray the two sets of lines forming a one-way or two-way barrier line concurrently.
- Apply the thermoplastic material uniformly with a cold film thickness of 3.0 mm.

Tolerances:
- Setting out: No more than 50 mm from the locations shown on the drawings.
- Lengths: To any applicable local or state requirements and not vary by more than ± 50 mm.
- Widths: ± 5 mm. Negative tolerance of 10 mm is allowable for no more than 5% of the length of line.
- Gap between double lines: ± 10 mm.
- Thickness: ≥1.8 mm, sprayed or extruded.

Beads for longitudinal lines: Conform to the following:
- Apply Type B glass beads by air propulsion or gravity feed to the surface of all longitudinal lines at a net application rate of 0.30 kg/m² immediately after application of the thermoplastic material.
- Set the actual application rate to overcome any loss of beads between the bead dispenser and the sprayed line.
- Apply Type D glass beads at a minimum rate of 0.5 kg/m².

Transverse lines
Tolerances:
- Setting out: No more than 50 mm from the locations shown on the drawings.
- Widths: ± 10 mm.
- Lengths: ± 10 mm.
- Thickness: 3 mm ± 1 mm, screeded.

Other marking
Dimensions: Conform to any applicable local or state requirements for the following:
- Arrows.
- Chevrons.
- Painted medians.
- Painted left turn islands.
- Speed markings.

Tolerance:
- Each dimension ± 50 mm.
- Thickness: 3 mm ± 1 mm, screeded.

Application of thermoplastic materials and beads
Arrows and speed markings: Place square with the centreline of the traffic lane.
Application: Uniformly apply the thermoplastic material Cold film thickness: 3.5 mm.
Screed application: Apply the screeded thermoplastic material using a mobile applicator, approved by the Superintendent, using templates to control the pattern.
Pavement marking appearance: Straight or with smooth, even curves where applicable. Provide a clean, sharp cut off. to all edges.
Faulty application: Remove any marking material applied beyond the defined edge of the marking and leave a neat and smooth marking on the wearing surface of the pavement.

Beads
Scope: Other than longitudinal lines.

Application:
- Uniformly apply Type B glass beads to screeded markings at a minimum application rate of 0.30 kg/m² immediately after application of the thermoplastic material by a method approved by the Superintendent.
- Apply Type D glass beads at a minimum application rate of 0.50 kg/m².

Field testing
Thickness of thermoplastic material: Check the thickness of the cold film of thermoplastic material applied to the road pavement by measurement, using a vernier or suitable dry film thickness gauge. Measure the thickness of the thermoplastic material applied to a metal test plate and take the mean of at least six readings distributed over the test area.
Glass beads application rate: Check the application rate of glass beads applied to the surface of the markings by the method described in Annexure A. This is a WITNESS POINT.

4.6 RESERVED

4.7 PAVEMENT MARKING TAPE

Application
Application: To conform with the manufacturer’s recommendations.
Removal: When directed remove pavement marking tape to conform with the manufacturer’s recommendations.
Rectify any damage to underlying linemarking/ RPPM’s caused by the removal of the temporary linemarking tape. This is a WITNESS POINT.

4.8 RAISED PAVEMENT MARKERS

Installation
Adhesive preparation: Freshly heat and mix the adhesive to the Manufacturer’s instructions. Do not allow the adhesive to cool and do not reheat prior to use.
Application of adhesive: Spread the adhesive uniformly over the underside of the raised pavement marker to a depth of approximately 10 mm.
Adhesion of marker to pavement: Conform to the following:
- Press the raised pavement marker onto the pavement surface in its correct position and rotate slightly until the adhesive is squeezed out around all edges of the marker.
- Do not disturb the raised pavement marker until the adhesive has set. This is a WITNESS POINT.

Rough surfaces
Locations: Newly laid coarse sprayed bituminous seals, and where directed by the Superintendent.
Adhesion of marker: Conform to the following:
- Apply an initial pad of adhesive of diameter 20 mm larger than the diameter of the base of the raised pavement marker.
- Apply the adhesive to fill the irregularities in the pavement surface to produce a flat, smooth surface flush with the upper stone level.
- Allow the adhesive pad to set.
- Apply additional adhesive to the pavement, as described above, and then press down the raised pavement marker onto the adhesive pad on the pavement surface to ensure good adhesion.

Tolerances:
- Longitudinal displacement: ± 20 mm.
- Lateral displacement: ± 20 mm.
- Directional: ± 4°.

4.9 REMOVAL OF REDUNDANT MARKINGS

Removal method
General: Conform to the following:
- Remove pavement markings without significant damage to the surface.
- Remove the markings in a ‘block type manner, so as to avoid ‘ghosted’ images.
- Black out of markings only as a temporary measure and complete the removal within 48 hours.
- Submit the method of removal for approval by the Superintendent at least 24 hours before commencement of the work. This is a HOLD POINT.

4.10 LIMITS AND TOLERANCES

Application
Summary: The limits and tolerances applicable to this worksection are summarised in Summary of limits and tolerances table.

Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
</table>

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<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Setting out</td>
<td>≤50 mm from specified location</td>
<td>Paint marking</td>
</tr>
<tr>
<td>Longitudinal Lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Length</td>
<td>To any applicable local or state requirements and not vary by more than ± 50 mm.</td>
<td>Thermoplastic marking</td>
</tr>
<tr>
<td>- Width</td>
<td>± 5 mm</td>
<td>Thermoplastic marking</td>
</tr>
<tr>
<td>Transverse lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Length and width</td>
<td>± 10 mm.</td>
<td>Thermoplastic marking</td>
</tr>
<tr>
<td>Arrows, chevrons, painted medians, speed markings etc.</td>
<td>Each dimension ± 50 mm.</td>
<td>Thermoplastic marking</td>
</tr>
<tr>
<td>Application of paint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Film thickness</td>
<td>Depends on the beads to be used:</td>
<td>Pavement marking</td>
</tr>
<tr>
<td></td>
<td>For type B beads—minimum 0.2 mm dry film;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>For type D beads—minimum 0.3 mm dry film</td>
<td></td>
</tr>
<tr>
<td>Application of thermoplastic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Longitudinal lines—Cold Film Thickness</td>
<td>≥1.8 mm, sprayed or extruded.</td>
<td>Thermoplastic marking</td>
</tr>
<tr>
<td>- Transverse Lines, Symbols, Arrows etc.</td>
<td>3 mm ± 1 mm, screeded.</td>
<td>Thermoplastic marking</td>
</tr>
<tr>
<td>Glass beads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Volume used in operation</td>
<td>Minimum type B—0.30 kg/m²</td>
<td>Pavement marking</td>
</tr>
<tr>
<td></td>
<td>Minimum type D—0.50 kg/m²</td>
<td></td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects all activities associated with completing the work detailed in this Worksection on a schedule of rates basis in accordance with Pay Items 1191.1 to 1191.6.

Lump Sum prices: Not acceptable.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
- No additional payment is to be made for maintenance and replacement of pavement markers in accordance with Maintenance of pavement markings.
- Provision for traffic is measured and paid in accordance with this worksection and not 1101 Control of traffic.

5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1191.1 Pavement marking paint—longitudinal lines</td>
<td>Line pattern km (including any gaps)</td>
<td>All costs associated with the setting out of the work, paint and</td>
</tr>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td>Calculate the area from the specified width (excluding tolerances) and the actual application length measured along the centre line of the longitudinal line.</td>
<td>beads and traffic control.</td>
</tr>
<tr>
<td>1191.2 Pavement marking paint—Transverse lines, symbols, legends, arrows, chevrons, traffic islands and kerbs</td>
<td>Linear metres Each Each m² m m² Each or m²</td>
<td>Determine the extent of the painted surface by direct measurement of the markings as applied. All costs associated with the setting out of the work, all material, supply and application and traffic control.</td>
</tr>
<tr>
<td>1191.3 Thermoplastic (or cold Applied Plastics) pavement marking material—Longitudinal lines</td>
<td>Line pattern km (including any gaps) Calculate the area from the specified width (excluding tolerances) and the actual application length measured along the centre line of the longitudinal line.</td>
<td>All costs associated with the setting out of the work, tack coating, supply and application of thermoplastic material and beads and provision for traffic.</td>
</tr>
<tr>
<td>1191.4 Thermoplastic (or cold Applied Plastics) pavement marking material - transverse lines, symbols, legends and arrows</td>
<td>Linear metres Each Each m² m m² Each or m²</td>
<td>Determine the extent of the thermoplastic material applied by direct measurement of the markings as applied. All costs associated with the setting out of the work, tack coating, supply and installation of all material and the provision for traffic.</td>
</tr>
<tr>
<td>1191.5 Raised pavement markers (all applications)</td>
<td>'Each' raised pavement marker installed</td>
<td>All costs associated with the setting out of the work, supply and installation of all material and provision for traffic.</td>
</tr>
<tr>
<td>1191.6 Removal of pavement markings</td>
<td>m²</td>
<td>All costs associated with removal and disposal.</td>
</tr>
</tbody>
</table>
6 ANNEXURE A

6.1 GLASS BEADS

Types of glass beads
Type A beads (premix): Type A beads are mixed into road-marking material by the manufacturer prior to application, and are intended to provide retroreflectivity throughout the life of the marking. Mix these beads at a rate of not less than 30% by mass.

Type B beads (drop-on): Type B glass beads are applied under gravity or pressure as a surface application to a wet film of pavement marking to provide initial retroreflectivity.

Smooth substrate: Apply on a smooth substrate.

Application: A nominal rate of 270–300 g/m² may be appropriate, while a coarse surface substrate usually requires a higher application rate to achieve the required level of retroreflectivity.

Coated: These beads have a moisture-proof coating to facilitate flow and reduce the risk of ‘caking’

Type C beads (intermix): Type C beads are mixed into thermoplastic road-marking material by the manufacturer prior to application, and are intended to provide retroreflectivity throughout the life of the marking.

Mix: Intermix these beads at a rate of not less than 20% by mass.

Type C: Type C beads may also be used for surface applications to a wet film of pavement marking to provide initial retroreflectivity. Apply on a smooth substrate. A nominal rate of 350 g/m² may be appropriate, while a coarse surface substrate usually requires a higher rate of application to achieve the required level of retroreflectivity. These beads are not moisture-proof coated, and, if used for surface applications, could ‘cake’ during handling.

Type D beads (large wet-weather beads): Type D glass beads are applied under gravity or pressure as a surface application to a wet film of pavement marking to provide initial retroreflectivity.

Substrate: Apply on a smooth substrate.

Application: A nominal rate of 500 g/m² may be appropriate, while a coarse surface substrate usually requires a higher rate of application to achieve the required level of retroreflectivity.

Coating: These beads have no moisture-proof coating and are, therefore, also suitable for intermixing into thermoplastic road-marking material to provide retroreflectivity in both dry and wet conditions, throughout the life of the marking. Intermix at a rate of not less than 20% by mass.

Measurement of application rate of spherical glass beads
Scope: Adopt the following procedure for field measurement of the rate of application of spherical glass beads on to wet paint or thermoplastic surfaces.

Spherical glass beads: To AS/NZS 2009.

Measurement: Use the following method of field measurement:
- Turn off the paint or thermoplastic supply valves and operate the glass bead dispenser for exactly 10 seconds allowing glass beads to run into a plastic bag or tray.
- Pour the glass beads from the bag or tray into a suitable measuring cylinder calibrated in millilitres to measure the volume of glass beads collected. Level, but do not compact, the glass beads in the cylinder.
- Compare the volume of glass beads collected with the correct figure given in Volume of glass beads (ml) required in 10 seconds of operation table.

Volume required for 0.30 kg/m²: The Volume of glass beads (ml) required in 10 seconds of operation table shows the correct volumes of glass beads required to give a net application rate on the marked line of approximately 0.30 kg/m² for different line widths and road speeds.

Volume required for 0.30 kg/m²: The glass bead volume figures given in the Volume of glass beads (ml) required in 10 seconds of operation table are calculated for an actual application rate of 0.34 kg/m². These figures are used for calibrating the machine because there is a loss of beads between the bead dispenser and the marked line and the volume is measured with beads not compacted.

Volume required for 0.50 kg/m²: For the calibration of application rates to suit type D beads, alter the Volume of glass beads (ml) required in 10 seconds of operation table to 0.50 kg/m².

Volume of glass beads (ml) required in 10 seconds of operation table

<table>
<thead>
<tr>
<th>Road speed (km/h)</th>
<th>Line widths</th>
</tr>
</thead>
</table>

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<table>
<thead>
<tr>
<th></th>
<th>80 mm</th>
<th>100 mm</th>
<th>120 mm</th>
<th>150 mm</th>
<th>200 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>396</td>
<td>495</td>
<td>594</td>
<td>742</td>
<td>990</td>
</tr>
<tr>
<td>13</td>
<td>643</td>
<td>804</td>
<td>965</td>
<td>1207</td>
<td>1698</td>
</tr>
<tr>
<td>16</td>
<td>791</td>
<td>990</td>
<td>1188</td>
<td>1484</td>
<td>1484</td>
</tr>
</tbody>
</table>

Notes:
1. Tolerance of ±10% is permissible when measuring the above volume.
2. When two or more glass bead dispensers are to be used, each dispenser is to be checked separately to make up the totals shown.
3. Glass beads weigh approximately 1.53 g/ml.
1 GENERAL

1.1 RESPONSIBILITIES

Objectives

General: Provide signs and support structures for Regulatory, Warning and Guide signs, proprietary Street Name and Community Facility Name Signs and adjust existing signs, as documented.

Performance

Requirements: Supply, erect and adjust the signs and support structures to conform with this worksection and as shown on the drawings and in accordance with the relevant Australian Standards at all times and conformance with Road and Maritime Services (RMS) requirements.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards

General: The following documents are incorporated into this worksection by reference:

Note: Only the most current standards are to be used

AS/NZS 1163 Structural steel hollow sections.
AS 1214 Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series).
AS 1379 Specification and supply of concrete.
AS/NZS 1554 Structural steel welding.
AS/NZS 1554.1 Welding of steel structures.
AS 1580 Paints and related materials—Methods of test.
AS 1580.108.2 Dry film thickness—Paint inspection gauge.
AS/NZS 1580.602.2 Measurement of specular gloss of non-metallic paint films at 20°, 60° and 85°.
AS 1627 Metal finishing—Preparation and pre-treatment of surface
AS 1627.1 Removal of oil, grease and related contamination
AS 1627.4 Abrasive blast cleaning of steel
AS 1627.9 Pictorial surface preparation standards for painting steel surfaces
AS 1742 Manual of uniform traffic control devices.
AS 1742.4 Speed controls
AS 1742.5 Street name and community facility name signs
AS 1743 Road signs—Specifications.
AS 1744 Forms of letters and numerals for road signs.
AS/NZS 1866 Aluminium and aluminium alloys—Extruded rod, bar, solid and hollow shapes.
AS/NZS 2311 Guide to painting of buildings.
AS 2700 Colour standards for general purposes.
AS/NZS 3678 Structural steel—Hot-rolled plates, floorplates and slabs.
AS/NZS 3679 Structural steel.
AS/NZS 3679.1 Hot-rolled bars and sections.
AS 4100 Steel structures.
AS/NZS 4871 Steel reinforcing materials.
AS/NZS 4880 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.
AS/NZS 4819  Rural and urban addressing

1.4 STANDARDS

General
Standard: To AS 1742.
Road signs: To AS 1743.
Letters and numerals for road signs: AS 1744.

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

Documents
- Proposed supplier.
- Materials and components: Submit alternatives for non-reflective materials where relevant.
- Execution details: Submit details of set-out.

1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table.

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street and community facility name signs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approval</td>
<td>Details of manufacturer materials and attachment systems</td>
<td>1 week prior to commencement of manufacture</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Regulatory, warning and guide signs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Evidence that materials and parts proposed comply with worksection requirements</td>
<td>1 week prior to engaging supplier</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Retro-reflective material for background and legend</td>
<td>Details of material and compatibility in application and durability</td>
<td>1 week prior to ordering</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Sign support structures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Details of suppliers and evidence of structural conformity</td>
<td>1 week prior to engaging supplier</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Attachment of signs</td>
<td>Details of proposed attachment systems</td>
<td>2 weeks prior to fabricating attachment systems</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Footing reinforcement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel reinforcement cages</td>
<td>Evidence of material conformity</td>
<td>1 week prior to fabrication</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Off-site requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspection</td>
<td>Notice of availability of sign structures for inspection</td>
<td>2 working days</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Clause/subclause</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td>Release by</td>
</tr>
<tr>
<td>------------------------</td>
<td>--------------------------------------------------</td>
<td>----------------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Establishment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing underground</td>
<td>Locate services and</td>
<td>1 week prior to erection</td>
<td>Superintendent</td>
</tr>
<tr>
<td>services</td>
<td>protect against damage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Details of set-out</td>
<td>1 week prior to erection</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table – On site activities**

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Footing reinforcement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel reinforcement</td>
<td>Splicing location and method</td>
<td>3 working days before splicing bars</td>
<td></td>
</tr>
<tr>
<td>cages</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clearing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Clear vegetation after set-out on advice from Council’s Tree Management Officer</td>
<td>3 working days before clearing</td>
<td></td>
</tr>
<tr>
<td>Sign structure footings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation</td>
<td>Excavation as shown on drawings and as directed, including disposal of material</td>
<td>1 working day before next activity</td>
<td></td>
</tr>
<tr>
<td>Erection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sign damage</td>
<td>Repair or replace damaged signs</td>
<td>1 week before installing signs</td>
<td></td>
</tr>
<tr>
<td>Adjustment of existing</td>
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<td></td>
<td></td>
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<tr>
<td>signs and support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>structures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Conform to Drawings and Superintendent direction</td>
<td>1 week before adjusting signs</td>
<td></td>
</tr>
</tbody>
</table>

2 **PRE-CONSTRUCTION PLANNING**

2.1 **SCHEDULING**

**Program for works**

Schedule: Signposts materials and on site locations.
Planning: Program the works to ensure adequate resources such as for control of traffic and locating existing underground services.

3 **MATERIALS**

3.1 **STREET AND COMMUNITY FACILITY NAME SIGNS**

**Drawings**

Information: Show the following information on drawings:
- Sign and legend selection and details.
- Support structures.
- Locations and mounting heights.

**Standards**

General: To AS 1742.5.
Road name: To AS/NZS 4819.
Speed control: To AS 1742.4.

**Signage system**

Local authority requirements:
- Conform to Council’s adopted signage system.
Proprietary sign requirements
Manufacture and installation: To the requirements of AS 1742.5 Street Name and Community Facility Name Signs, to the following details:
- As required by the Conditions of Development Consent.

Approval
Submission: Submit details of the manufacturer for all sign materials and sign attachment systems prior to commencement of sign manufacture. This is a HOLD POINT.

3.2 REGULATORY, WARNING AND GUIDE SIGNS

Drawings
Information: Show the following information on drawings:
- Sign and legend selection.
- Support structures of the following types:
  - Standard round galvanised steel posts of size 50, 65 or 80 mm nominal bore, fitted with a cap for waterproofing.
  - Purpose-designed steel structures as shown on the Drawings and manufactured to AS 4100.
- Anchor bolt assemblies.
- Locations and mounting heights.

Standards
Sign and legend dimensions and details: To AS 1743.

General
Supplier: Advise the names of the proposed suppliers of signs for the Superintendent's approval. Use suppliers who have previously established, or can now establish, their competence to carry out the work to conform with this worksection.

Proof of quality: Supply documentary evidence that all materials and parts proposed for use comply with the requirements of this worksection. This action is a HOLD POINT.

Temporary signs: Install temporary signs for the control of traffic nominated in 1101 Control of Traffic.

Sign blanks
Aluminium quality: Free of cracks, tears and other surface blemishes and the edges true and smooth. Aluminium sheet alloy thickness of Sign blanks: 1.6 mm.
Type and temper: Type 5251 or Type 5052 and Temper H38 or Temper H36 to AS 1743.
The dimensions of the sign blank: ± 1.5 mm of the dimensions specified.
The finished sign: Flat within a maximum allowable bow of 0.5% of the maximum dimension of the sign blank in any direction.

One piece blanks: Provide one piece sign blanks if size permits otherwise, construct a multipiece sign.
Multipiece sign: Construct as follows:
- Minimise the number of sheets butted with 1 mm maximum gap at any point along the joint.
- Cover all joints by a backing strip of the same material and colour as used for the sign blank and with a minimum width of 50 mm over the full length of the joint.
- Fix the backing strip to each sheet with rivets, colour matched and at 200 mm maximum spacings.
Aluminium extrusion as backing strip: The aluminium extrusion used for mounting may be used as the backing strip for horizontal joints where it complies with the spacing requirements.
Face treatment: Chemically clean and etch or mechanically abrade the face of each sign blank. If the sign blank is to receive a paint background, spray paint the face with a compatible primer.
Back treatment: Uncoat the back of each sign blank and render the surface finish dull and non-reflective either by mechanical or chemical means and free of scratches and blemishes.
Mounting: Supply the signs with square holes or aluminium extrusion backing for mounting purposes, at the centre spacings as shown on the drawings.

Aluminium extrusion backing
Design section: Include the special aluminium extruded sections, as shown on the drawings, for mounting purposes.
Aluminium Type: 6063-T5 to AS/NZS 1866.
Fixing: Fix the aluminium extrusion at the centre spacings as shown on the drawings and fix to the sign blank with colour matched rivets at 200 mm maximum spacings.

**Rivets**
Type: Domed head and shank of aluminium alloy with a steel mandrel.
Colour matching: Paint head and shank with alkyd enamel over an etch primer prior to insertion.

**Retro-reflective material for background and legend**
Approval: Required for the material and compatibility, both in application and durability. This is a HOLD POINT.
Standard: To AS 1743 for Class 1, Class 2 and Class 2A materials. Unless shown otherwise on the Drawings; provide Class 2 material.
Application: Apply retroreflective material to the sign blank to conform with the manufacturers recommended methods so that it is completely adhered without bubbles, cracks or blemishes.

**Non-reflective background material—Background paint**
Paint system:
- Primer: One coat 2-pack epoxy.
- Finishing coats: Two coats 2-pack polyurethane (B20) or acrylic polyurethane (B44).
- Standard: To AS/NZS 2311 clause 5.2.
Application: Apply the paint using conventional air spray application to give a uniform cover free of blemishes. A minimum dry film thickness of 38 microns is required when tested to conform with AS 1580.108.2.
Colours: To AS 1743 from one of the following AS 2700 colours:
- Red: R13 Signal Red.
- Yellow: Y14 Golden Yellow.
- Brown: X65 Dark Brown.
- Blue: B11 Rich Blue.
- Standard Green: G12 Holly Green.
- Freeway Green: Emerald.
Background colours: From one of the following AS 2700 colours:
- White—Gloss.
- ‘Dark Grey’—Matt Colour No N64.
Exact colorimetric values: To AS 2700.
Gloss levels:
- Matt coatings: Between 12 % - 15 % of gloss as determined by AS/NZS 1580.602.2, using an 85° head
- Gloss coatings: Between 85% - 95% of gloss as determined by AS/NZS 1580.602.2 using a 20° head.

**Non-reflective background material—Background sheet material**
Quality: Adhesive cast vinyl sheet material or other equivalent approved material can be provided in place of background paint. Provide material of uniform density compatible with the material provided for the legend, both in application and durability.
Colours and gloss: Provide uniform colours and gloss levels and conform to the requirements as above.
Application: Apply sheet material to the sign blank in accordance with the manufacturers recommended methods so that it is completely adhered without bubbles, cracks or blemishes.

**Non-reflective material for legend—Legend screening ink**
Quality: Provide high quality screening ink, full gloss, non-fade, non-bleed and scratch resistant type of ink compatible with the material to which it is applied. Provide screening ink with durability at least equal to the material to which the screening ink is applied.
Application: Apply screening ink legends to the background material in conformance with the manufacturers recommended methods.
Non-reflective material for legend—Legend sheet material
Quality: Adhesive cast vinyl sheet material or other equivalent approved material can be provided in place of screening ink. Provide material of uniform density and compatible with the material provided for the background both in application and durability.
Application: Apply sheet material legends to the background material in conformance with the manufacturers' recommended methods so that it is completely adhered without bubbles, cracks or blemishes.

Non-reflective material for legend—Colours and finish
General: The requirements of Regulatory, warning and guide signs also apply to non-reflective materials for legends but additional colours complying with AS 2700 may be specified.

Reference markings
Identification code:
- Clearly and permanently stamp or engrave all warning, regulatory and guide signs with an identification coding. Do not damage the front face.
- Code cipher height: Between 6 and 10 mm.
Code location: At the rear face to the bottom left hand corner of rectangular signs and on or below the horizontal centre line to the left hand rear edge of other shaped signs.
Information required:
- Sign reference number.
- Manufacturer's Name.
- Month and Year of Manufacture.
- Manufacturer and Class of Retro-Reflective Material.
Proprietary signs: The requirements for reference markings do not apply to proprietary street name or community facility name signs.

Protection of signs
Protection: Protect the signs from damage during storage and transportation to site.

3.3 SIGN SUPPORT STRUCTURES

General
Scope: Provide materials, fabrication of components and protective treatment of the sign support structures and anchor bolt assemblies, and the supply and fabrication of footing reinforcement cages.
Approved supplier: Provide the following for approval:
- Names of the proposed suppliers of sign support structures.
- Proof of competence: Suppliers who have previously established, or can now establish, their competence to carry out the work to conform with this worksection.
- Proof of quality: Supply documentary evidence that all materials and parts proposed for use conform with the requirements of this worksection.
- Fabrication details proposed. This is a HOLD POINT.
Structure details: Provide details of the sign support structures under the Contract on the drawings.

Fabrication
Standards: Fabricate purpose-designed steel structures from steel sections to AS/NZS 1163, AS 3678 and AS/NZS 3679.1.
Splices: Conform to the following:
- Restrict splices in members to a maximum of one splice per member.
- Provide splices of full penetration butt welds.
Welding to AS 1554.1: Category SP for sign structure welds and Category GP for anchor bolt assemblies.
Anchor bolts: Fabricate anchor bolt assemblies for purpose-designed structures.
Finish: Finish all steelwork free from pitting, sharp corners and projections and clean of mill scale, loose rust and foreign particles.
Preparation for galvanising: Provide the following:
- Chemical clean to AS 1627.1.
- Abrasive blast cleaning to AS 1627.4.
- Grade: Sa 2 ½ to AS 1627.9.

**Protective treatment**

Galvanizing:
- Prefinished: Standard galvanised steel posts.
- Hot dip galvanizing after fabrication: All steel components including brackets and anchor bolt assemblies as follows:
  - Average minimum coating thickness of 85 microns and a bright finished surface free from white rust and stains, to AS/NZS 4680.

- Bolts and nuts: To AS 1214.

Splices in galvanized posts: Paint splices in standard galvanized steel posts by using an organic zinc-rich primer, or inorganic zinc silicate paint, in accordance with the repair requirements in Clause 8 of AS/NZS 4680.

**Attachment of signs**

Typical systems: Provide posts and other components with the required sign attachment holes or fittings to suit the typical attachment systems as shown on the drawings. Attach sign panels to each supporting member at each extrusion section or bolt hole in the sign panel.

Contractor's responsibility: Submit details of the proposed attachment systems for approval. This is a HOLD POINT.

3.4 **FOOTING REINFORCEMENT**

**Steel reinforcement cages**

Standards: To AS/NZS 4671.

Evidence of quality: Supply evidence that all materials conform with the requirements of this worksection. This is a HOLD POINT.

Cleanliness: Provide steel reinforcement free from loose or thick rust, grease, tar, paint, oil, mud, millscale, mortar or any other coating, but not to a smooth polished condition.

Accuracy: Bend reinforcement to the dimensions and shapes shown on the drawings. Do not permit heating of reinforcement for purposes of bending unless Grade 400 deformed bar reinforcement is specified.

Full bars: Furnish all reinforcement in the lengths indicated on the drawings. Splicing of bars will only be permitted with the approval of the Superintendent as to the location and method of splicing. This is a WITNESS POINT.

Splicing: Measure splicing in reinforcing fabric as the overlap between the outermost wire in each sheet of fabric transverse to the direction of splice, but not less than the pitch of the transverse wires plus 25 mm.

Welded splices and tack welding of bars: To AS 1554.

3.5 **OFF-SITE REQUIREMENTS**

**Identification**

Purpose-designed structure: Provide information as follows:
- Locations: The post column one metre above base plate, the outreach arm, and the sign support vertical fixing.
- Information shown:
  - Sign reference number.
  - Manufacturer's name.
  - Month and year of manufacture.
  - Drawing Number.

Marking: Legible, durable and applied by etching, stamping, engraving or welding.

Warranty: This marking is additional to date stamping required under Sign structure warranty.

**Inspection**

Pre-delivery Inspection: All purpose-designed structures covered by this worksection are subject to an inspection at the Contractor's Works prior to acceptance.
Notice: Notify the Superintendent of the availability of the sign structures for pre-storage or pre-delivery inspection. This is a HOLD POINT.

**Inspection certificate**
General: The Superintendent will issue the Contractor with a Certificate listing particulars of the items inspected.

The Certificate will indicate either:
- The sign structures satisfy the requirements of the work section and are to be accepted; or
- The grounds for rejection of the goods.

**Storage**
Storage: Store the sign support structures and reinforcement cages until required to be incorporated into the Works or required by the Superintendent.

Store completed reinforcement cages under a waterproof shelter and supported above the surface of the ground, and protected from damage and from deterioration due to exposure.

4 EXECUTION

4.1 **PROVISION FOR TRAFFIC**

**Minimise inconvenience**
Minimise delay: Provide for traffic to conform with 1101 Control of traffic while undertaking the work and organise the work to avoid or minimise delays and inconvenience to traffic, both vehicular and pedestrian.

**Premature sign exposure**
Secure sign: Where a sign is erected before it is intended for use by traffic and is visible to traffic, completely and securely wrap the face of the sign in porous cloth sheeting or other approved opaque covering material until the Superintendent directs that the sign is to be uncovered.

4.2 **ESTABLISHMENT**

**Existing underground services**
Services laid in proximity to the signs: Locate prior to placement of footings and erection of signs and protect services from damage. This is a HOLD POINT.

Location: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, for locating underground pipe and cables (possible within two working days). See www.1100.com.au.

**Alignment**
General: Comply with the following:
- Align signs approximately 5 degrees away from a right angle to the direction of traffic they are intended to serve.
- On curved alignments, determine the angle of placement by the course of approaching traffic rather than the orientation of the road at the point where the sign is located.

**Location**
General: Locate the signs as shown on the drawings or as directed by the Superintendent.

On site: Set out the work to ensure that all signs and support structures are placed as shown on the drawings or as directed by the Superintendent.

Submissions: Submit details of the set out and the proposed disposition and alignment of each sign support structure. This is a HOLD POINT.

4.3 **CLEARING**

**General**
Clearing vegetation: Following set out approval and advice from Council’s Tree Management Officer clear and remove any trees and undergrowth within 3 m of the sign support structure and along a driver’s line of sight to the front of the sign. This is a WITNESS POINT.

4.4 **SIGN STRUCTURE FOOTINGS**

**Details**
Construction: Construct the footings for a simple pipe support, or the footings for each post of a purpose-designed sign support structure, as shown on the drawings or as directed.
Excavation
Excavation and disposal: Neatly excavate footings to the depth and width shown on the drawings. Do not excavate by machine within 1 m of existing underground services. Dispose of the material from the excavation in an approved manner. This is a WITNESS POINT.

Anchor bolt assemblies
General:
- Accurately place and provide firm support.
- Provide anchor bolt assemblies with levelling nuts under the sign structure baseplates to allow adjustment of the structure after installation.
- Protect all exposed bolt threads from damage or adhesion of concrete during footing construction.

Steel reinforcement
General: Place steel reinforcement as shown on the drawings.

Concrete quality
Concrete in the footings of sign support structures: To 0319 Minor concrete works and having a minimum compressive strength:
- 20 MPa at 28 days for pipe support footings.
- 32 MPa at 28 days for purpose-designed support footings.

Ready mixed concrete
Standard: If ready mixed concrete is used, mix and deliver to AS 1379.

4.5 ERECTION

Position and support
General: Accurately position and support all components during erection.

Top of post
Requirements: To conform with the following:
- Extend the top of each pipe support post beyond the upper extrusion section or bolt holes on the sign panels to enable attachment of the signs.
- Finish the top of each post below the top edge of the sign panel.
- Multi-post installations: Finish the tops of the posts at the same level except where sign shape or the arrangement of sign panels dictates otherwise.

Sign damage
Protection: During erection, support and brace sign panels and protect the sign face from damage.

Repair: Repair signs damaged during erection to a standard equivalent to the original sign or replaced by the Contractor at the Contractor’s cost. This is a WITNESS POINT.

Treatment of damaged areas
Protective treatment: To conform with the following:
- Scratched and slightly damaged areas not exceeding 2500 mm² on any one structure: Repair with an organic zinc-rich primer, or inorganic zinc silicate paint, to the repair requirements of AS/NZS 4680.
- Totally-damaged coating areas exceeding 2500 mm²: Regalvanize.

4.6 ADJUSTMENT OF EXISTING SIGNS AND SUPPORT STRUCTURES

General
Adjustment of existing signs: Where shown on the drawings and where directed by the Superintendent, adjust existing sign panels and sign support structures. This is a WITNESS POINT.

Scope:
- Minor adjustments of sign panels and/or sign support structures.
- Dismantling of signs and sign support structures
- Relocation or replacement of sign support structures including footings and re-erection of signs.

4.7 SIGN STRUCTURE WARRANTY

General
Scope: Supply of any structure under this worksection.
Warranty period: 2 years for subdivisions and 1 year for public engineering works from completion of works.
Failed or defective structures: Obligations:
- Remove any sign structure which has failed in service or found defective within 12 months from completion of works.
- Make good the defect or arrange to have the defect made good, and subsequently return and re-erect the good unit at the original location at no charge to the Principal.
- Unless otherwise agreed, process and return defective structures within 30 calendar days from the date the Contractor is notified by the Principal of the defect.
Warranty exclusion: Any structure which has failed as a result of a traffic accident, abuse or act of vandalism caused by a third party after delivery to the site is not covered by warranty provisions.
Date of dispatch mark: In order to facilitate checking of warranty claims, legibly stamp, etch or engrave the date of dispatch from the Contractor's Works to the Site on all separate items of the sign structure.

### 4.8 LIMITS AND TOLERANCES

#### Application
Summary: The limits and tolerances applicable to this worksection are summarised in **Summary of limits and tolerances table**.

#### Summary of limits and tolerances table

<table>
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<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause Reference</th>
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</thead>
<tbody>
<tr>
<td>Sign blank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions</td>
<td>± 1.50 mm of specified dimensions</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>Bow</td>
<td>&lt; 0.5% of maximum dimension</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>Butt gap in multipiece sign</td>
<td>&lt; 1 mm</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>Rivet spacing in backing strip</td>
<td>&lt; 200 mm</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>Backing strip width</td>
<td>&gt; 50 mm</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>Extrusion Backing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rivet Spacing</td>
<td>&lt; 200 mm</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>Background Paint</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For matt coatings, gloss level</td>
<td>Between 12% - 15%</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>For gloss coatings, gloss level</td>
<td>Between 85% - 95%</td>
<td>Regulatory, warning and guide signs</td>
</tr>
<tr>
<td>Reference marking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Height of Coding</td>
<td>Between 6 mm - 10 mm</td>
<td>Reference markings</td>
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<tr>
<td>Sign Support Structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective Treatment thickness</td>
<td>&gt; 85 microns</td>
<td>Sign structures and anchor bolt assemblies</td>
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<tr>
<td>Paint coating over Splices in</td>
<td>&gt; 100 microns</td>
<td>Sign structures and anchor bolt assemblies</td>
</tr>
<tr>
<td>standard galvanised posts</td>
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<tr>
<td>Damaged surface of galvanised</td>
<td></td>
<td></td>
</tr>
<tr>
<td>surfaces:</td>
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<tr>
<td>- Coating with zinc rich paint</td>
<td>Area &lt; 2500 mm²</td>
<td>Erection</td>
</tr>
<tr>
<td>- Regalvanise</td>
<td>Area &gt; 2500 mm²</td>
<td>Erection</td>
</tr>
<tr>
<td>Clearing</td>
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<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Limits/Tolerances</td>
<td>Worksection Clause Reference</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>--------------------------------</td>
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</tr>
<tr>
<td>Trees and Undergrowth to be cleared</td>
<td>&lt; 3 m from sign support structure</td>
<td>Clearing</td>
</tr>
<tr>
<td>Concrete in footings of sign support structures</td>
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</tr>
<tr>
<td>Strength</td>
<td></td>
<td>Sign structure footings</td>
</tr>
<tr>
<td>- Pipe support footings</td>
<td>20 MPa at 28 days</td>
<td>Sign structure footings</td>
</tr>
<tr>
<td>- Purpose-designed support footings</td>
<td>32 MPa at 28 days</td>
<td></td>
</tr>
</tbody>
</table>

### 5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

#### 5.1 MEASUREMENT

**General**
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, as shown on the drawings and Pay items 1192.1 to 1192.12 inclusive.

Lump Sum prices: Not acceptable.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

**Methodology**
The following methodology will be applied for measurement and payment:
- The cost of any provision for traffic and covering of signs is deemed to be included in the various Pay items in this worksection and not 1101 Control of traffic.
- Sign structure support concrete footings: In conformance with this worksection and not 0319 Minor concrete works.
- Miscellaneous minor concrete work not included in the Pay items in this worksection: In conformance with Pay items described in 0319 Minor concrete works.

#### 5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay Items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1192.1 Supply and delivery of signs (area less than 1 m²)</td>
<td>Each</td>
<td>All costs of mounting extrusions, fittings, labelling, packaging and delivery to site.</td>
</tr>
<tr>
<td>1192.2 Supply and delivery of signs (area between 1 m² and 3 m²)</td>
<td>Each</td>
<td>All costs of mounting extrusions, fittings, labelling, packaging and delivery to site.</td>
</tr>
<tr>
<td>1192.3 Supply and delivery of signs (area greater than 3 m²)</td>
<td>m² of signs supplied</td>
<td>The total face surface area of each sign supplied. All costs of mounting extrusions, fittings, labelling, packaging and delivery to site.</td>
</tr>
<tr>
<td>1192.4 Supply and delivery of sign support structures (standard round galvanised posts)</td>
<td>Each post</td>
<td>All costs of fabrication, fittings, caps, packaging, storage for up to 2 months and delivery free on truck</td>
</tr>
<tr>
<td>1192.5 Supply and delivery of sign support structures (purpose-</td>
<td>Each sign support structure. Note: Where a purpose-</td>
<td>All costs of fabrication, hot-dip galvanising, fittings,</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>designed)</td>
<td>designed sign support structure consists of more than one post, the unit of measurement (each) to include all posts required for that particular sign.</td>
<td>packaging, storage for up to 2 months and delivery free on truck.</td>
</tr>
<tr>
<td>1192.6 Supply and delivery of anchor bolt assemblies 1192.6(1) 1192.6(2) 1192.6(3) 1192.6(etc)</td>
<td>Each for the anchor bolt assemblies for each individual footing</td>
<td>All costs of fabrication, hot-dip galvanising, fittings, packaging, storage for up to 2 months and delivery free on truck.</td>
</tr>
<tr>
<td>1192.7 Supply and delivery of reinforcement cages 1192.7(1) 1192.7(2) 1192.7(3) 1192.7(etc)</td>
<td>Each for the complete reinforcement cage for each individual footing</td>
<td>All costs of fabrication, packaging, storage for up to 2 months and delivery free on truck.</td>
</tr>
<tr>
<td>1192.8 Erection of sign structures (standard round galvanized posts)</td>
<td>Each post erected</td>
<td>All costs of clearing, excavation, casting of concrete footings, erection and bracing.</td>
</tr>
<tr>
<td>1192.9 Erection of sign structures (purpose-designed)</td>
<td>Each sign support structure erected. Note: Where a purpose-designed sign support structure consists of more than one post and footing, the unit of measurement (each) to include all posts and footings required for that particular sign.</td>
<td>All costs of clearing, excavation, placement of reinforcement cages and anchor bolt assemblies, casting of concrete footings, erection and bracing.</td>
</tr>
<tr>
<td>1192.10 Erection of signs (to standard round galvanized posts)</td>
<td>Each sign erected</td>
<td>All costs of erection and attachment costs and any necessary temporary covering of signs with plastic or other approved opaque covering.</td>
</tr>
<tr>
<td>1192.11 Erection of signs (to purpose-designed structures)</td>
<td>m² of signs erected</td>
<td>The total face surface area of the signs. All costs of erection and attachment costs and any necessary temporary covering of signs with plastic or other approved opaque covering.</td>
</tr>
<tr>
<td>1192.12 Adjustment of existing signs and support structures</td>
<td>m² of signs adjusted. Note: Separate pay items to be included for each adjustment required to re-erect existing signs and sign support structures and to cover all work required that is</td>
<td>The total face surface area of the signs adjusted. All costs of dismantling of signs and sign structure, relocation or replacement of sign structures including excavation, concrete</td>
</tr>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td>not covered by the other pay items under signposting.</td>
<td>footings, (including placement of reinforcement cages and anchor bolt assemblies where specified) and re-erection of signs including all fittings.</td>
</tr>
</tbody>
</table>
1193 GUIDE POSTS

1 GENERAL

1.1 RESPONSIBILITIES

General
General: Provide guide posts including supply of materials, protective treatment, erection and attachment of delineators, as documented.

Performance
Requirements: Guide Posts are to be plastic with a flexible base. Installation as per Roads and Maritime Services (RMS) specifications.
Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used
AS 1742 Manual of uniform traffic control devices
AS 1742.2 Traffic control devices for general use
AS/NZS 1906 Retroreflective materials and devices for road traffic control purposes.
AS/NZS 1906.2 Retroreflective devices (non-pavement application).
RMS Specification. 3412, Supply of Guide Posts

1.4 STANDARDS

General
Standard: To AS 1742.2.

1.5 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply:
- Delineator: The small retroreflectors or panels of retroreflective sheeting that are attached to guideposts to provide a coherent pattern of delineation of the edges of the carriageway as an aid to night driving.
- Flexible guide post: A guide post that deflects when impacted by a vehicle and then returns to the vertical position, without maintenance intervention.
- RMS- Roads and Maritime Services.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.
Documents
Requirement: Submit the following for approval:
- Materials:
  - Technical specifications and certificates of proprietary non-timber posts.

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- Drawings: Set out for post locations.
- Execution details: Refer to WITNESS POINTS – On-site activities.

1.7 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proprietary posts (Non timber) – Proposed supplier</td>
<td>Proposal for supplier and manufacturer details</td>
<td>Two weeks before manufacture</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment – Existing underground services</td>
<td>Check for services</td>
<td>5 working days</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Establishment – Location of guide posts</td>
<td>Locations shown on drawings or as specified</td>
<td>Two weeks before installation</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Installation of guide posts – Guide posts on concrete pavements</td>
<td>Provide fixing details</td>
<td>5 working days</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Installation of guide posts – Proprietary guideposts</td>
<td>Provide manufacturers anchorage instructions</td>
<td>5 working days</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

WITNESS POINTS table – On-site activities

<table>
<thead>
<tr>
<th>Clause/ subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation of guide posts - Backfilling</td>
<td>Firm embedment in ground</td>
<td>Progressive</td>
</tr>
<tr>
<td>Delineators - Fixing</td>
<td>Arrangement of delineators relative to traffic direction</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Pre-planning
Schedule: Posts, treatment and locations.
Planning: Program the works to ensure adequate resources such as for the control of traffic and locating existing underground services.

3 MATERIALS

3.1 PROPRIETARY POSTS (NON-TIMBER)

Proposed supplier
Proposal: Provide the details of the proposed plastic guide post including the following:
- Type of material. Guide post is to be fully flexible and made from plastic – (no metal or timber guide posts to be used). To comply with RMS Specification 3412, Supply of Guide Posts.
- Manufacturer’s recommended installation procedure.
- Technical specifications.
- Test certificates including post strength, flexibility, impact and heat and cold resistance and durability.
- Performance guarantee statement endorsed with the warranty period and the expected service life. This is a HOLD POINT.

**Specification**
Surface of posts: Durable plastic surfacing. Whiter than Y35 Off White of AS 2700S. Smooth and easily cleaned finish.

**Dimensions**
Minimum height above ground surface: 1000 ± 100 mm.
Minimum width of the above ground section of the guide post: Plastic Extrusion.
Thickness: To comply with RMS Specification - 3412, Supply of Guide Posts

**Anchorage**
Certification: Ensure the guide posts resist bending, twisting and displacement due to wind and/or impact forces.
Resistance: They must be effective in resistance to vertical removal by persons other than personnel using recommended removal tools.

**Physical properties and performance**
Durability: No deterioration in physical properties of the guide post material after a minimum of 720 hours under accelerated weatherometer conditions.
Heat resistance: Flexible guide posts must not deflect more than 50 mm after being heated as in Heat resistance test.
Cold resistance: flexible guide posts must show no signs of fractures, cracks or splits when cooled as in Cold resistance test.
Rigidity: At 23°C (± 2°C) the guide post must not be able to rotate in a clamp suited to the post profile.

**Markings**
Traceability: Each post must be legibly and indelibly marked with the following:
- Name of the supplier.
- Month and year of manufacture.

Letter Size: Must be between 5 and 10 mm high.
Placement: Place the markings on at least one side of the guide post and 500 mm from the top of the guide post.
Ground level for installation: Clearly mark guide posts 1000 mm from the top to show the ground level for installation.

**End treatment**
Plastic: The tops of guide posts manufactured from plastic must incorporate rounded edges and corners.

3.2 **RESERVE**

3.3 **DELINEATORS**

**General**
Standard: To AS/NZS 1906.2.
Type: Provide one of the following for each post:
- Corner-cubed: 80-85 mm diameter.
- Class 1A retroreflective sheeting: Minimum 0.01 m² (minimum width 50 mm).
Delineator location: Centrally locate delineators between the edges of the guide posts and placed so that the top of each delineator is between 50 and 100 mm from the top of the guide post.
Fixings: Fix the delineators to the guide post so that they are weatherproof and vandal resistant and so that they can be replaced if necessary without damaging the guide post.
Impact damage: Corner cube delineators that can be damaged by vehicular impact must not be used on flexible guide posts.
Consistency: Provide the same type of delineator on each post for a minimum distance of 2 km. Do not change delineator type within this distance.
4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 ESTABLISHMENT

Safety
Control of traffic: To Control of traffic.

Precautions: Take all necessary steps to prevent people and stock from stepping into the post holes during the erection of the guide posts.

Existing underground services
Excavation: Do not excavate by machine within 1 m of existing underground services.

Location: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, for locating underground pipe and cables (possible within two working days). See www.1100.com.au. This is a HOLD POINT.

Location of guide posts
Standard: To AS 1742.2 and as shown on the drawings.

Placement: Place the guide posts at a uniform distance from the pavement edge and as follows:
- If the shoulder is adjacent to an embankment or at the surrounding natural surface level, place the guide posts such that the inside edge is in line with the outside edge of the shoulder
- If the shoulder is located in a cutting, place the guide posts on the road pavement side of the table drain in such a manner as not to impede the flow of water in the drain. This is a HOLD POINT.

4.3 NON TIMBER POST TESTS PROCEDURES

Heat resistance – Flexible guide posts
Heat: Condition guide posts at 60°C(± 2°C) for 2 hours in an oven.
Test procedure: Conform with the following:
- Remove the guilde post from the oven.
- Clamp the base so that the guide post is vertical with the top of the guide post protruding 1000 mm.
- Bend the conditioned post adjacent to the clamp in the direction of the adjacent traffic flow to form a 90° angle.
- Subject the post to 3 cycles of bending through 180° all within 2 minutes of its removal from the oven.
- Finish the bending in a right angle.
- Release the post.
- Record the horizontal deflection at the top of the post from a vertical line 30 seconds after release from the bent position.

Tolerance: Deflection must not exceed 50 mm.

Physical condition: The post must show no signs of fractures, cracks or splits.

Cold resistance – Flexible not metallic guide posts
Cool: Condition the guide post at 0°C (± 2°C) for 2 hours in an ice bath.
Test procedure: Conform with the following:
- Remove the guide post from the ice bath.
- Clamp in a vertical position with the top of the post protruding 1000 mm.
- Bend the conditioned post adjacent to the clamp in the direction of the adjacent traffic flow to form a 90° angle within 30 seconds of its removal from the ice bath.
- Manually straighten a semi-flexible guide post.
- Release the post from the clamp 60 seconds after removing it from the ice bath and place the guide post in the ice bath for an additional 60 seconds.
- Repeat the bending and ice bath four times.
- Release the post from the bent position and immediately record the horizontal deflection at the top of the guide post from a vertical line 60 seconds after release.

  Tolerance: The deflection must not exceed 50 mm.

  Physical condition: The post must show no signs of fractures, cracks or splits.

4.4 INSTALLATION OF GUIDE POSTS

Positioning
General: Set guide posts vertically in the shoulder pavement as follows:
- Embedded depth:
  - Flexible guide posts: 350 mm.
- Shoulder irregularities: Vary this depth so as to give uniform display of guide posts to a height of approximately 1000 mm above ground level, with the tops evenly graded.
- Install each guide post with the 100 mm axis at right angles to the centre line of the road.

Vertical alignment
Allowance: Make allowance in the height of guide posts above the ground for the effects of superelevation and other road geometry in order to keep the guide posts within the range of the beam of vehicle headlights.

Guide posts on concrete pavements
Submission: If the guide posts are installed on concrete pavements, provide details of fixing the guide posts to the concrete. This is a HOLD POINT.

Proprietary guideposts
Resistance to impact: Provide proprietary guideposts that, when installed in the ground conforming with the recommendations of the manufacturer, resist overturning, twisting and displacement from wind and impact forces. Provide manufacturers instructions for anchorage. This is a HOLD POINT.

4.5 DELINEATORS

Standard
Quality: Provide delineators to AS/NZS 1906.2.

Fixing
Proprietary posts: Provide a delineator fastening system that is not dislodged or rendered inactive under vehicular impact.

Position: Mount the delineators so that the top of the reflector is 50-100 mm below the top of the guide post.

Arrangement: Arrange the delineators so that drivers approaching from either direction will see only red delineators on their left side and white delineators on their right side. This is a WITNESS POINT.

4.6 REMOVAL AND DISPOSAL OF EXISTING GUIDE POSTS

General
Extent: As shown on the drawings or as directed.

Removal: Include extracting all posts and other in-ground components and materials.

Backfilling: Backfill all holes after removal of existing guide posts and compact to the relative compaction of the surrounding shoulder material in layers of maximum depth of 150mm. Provide imported backfill material with similar characteristics to the shoulder material.

Disposal: All existing guide posts that are removed must be removed from site or otherwise disposed of as directed. Recycle existing posts manufactured from recyclable materials.

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1193.1.

Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

**Methodology**
The following methodology will be applied for measurement and payment:
Traffic control: To conform with 1101 Control of traffic.

### 5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay Items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1193.1 Guide posts</td>
<td>'Each' guide post</td>
<td>All costs associated with the erection of each post, including supply of post, erection, painting (if applicable), and supply and fixing of corner-cubed delineators.</td>
</tr>
<tr>
<td>1193.2 Removal of existing guide posts</td>
<td>'Each' guide post</td>
<td>All cost associated with the supply, placement and compaction of backfill material for the reinstatement of guide post hole and the collection and disposal of the existing guide posts.</td>
</tr>
</tbody>
</table>
1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide non-rigid road safety barriers and terminals as documented.

Performance
Requirements: Supply and erect non rigid safety barriers and terminals to AS/NZS 3845 as shown on the drawings or as directed to conform with 0161 Quality (Construction).

Design
- Design details and all the design parameters for the project design. Designer: As required by the Conditions of Development Consent and RPEng / CPENG.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this work section by reference:

Note: Only the most current standards are to be used

AS 1214 Hot-dip galvanised coatings on threaded fasteners (ISO metric course thread series)
AS 1237 Plain washers for metric bolts, screws and nuts for general purposes
AS 1237.1 General plan
AS 1237.2 Tolerances
AS/NZS 1594 Hot-rolled steel flat products
AS 1627 Metal finishing - Preparation and pre-treatment of surfaces
AS 1627.4 Abrasive cleaning of steel
AS 1627.5 Pickling
AS/NZS 1906 Retroreflective materials and devices for road traffic control purposes
AS/NZS 1906.2 Retroreflective devices (Non pavement application)
AS/NZS 3845 Road safety barrier systems
AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles

1.4 STANDARDS

General
Standard: To AS/NZS 3845.

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this work section the abbreviations given below apply:
- MELT: Modified eccentric loader terminal.

Definitions
General: For the purposes of this work section the definitions given below apply:
- Clear zone: The horizontal width of space available for the safe use of an errant vehicle which consists of the verge area and is measured from the nearside edge of the left-hand traffic lane.
the case of a divided road, it is also measured from the offside edge of the right-hand traffic lane to the edge of the pavement for opposing traffic.

- MELT: A public domain gating terminal.
- Non-rigid road safety barrier system: A road safety barrier system where elements are designed to move substantially in a crash, and where energy is absorbed by movement of the road safety barrier system and deformation of the vehicle.
- Tri-beam: The triple corrugated beam component of a public domain non-rigid road safety barrier system.
- Transition beam: The corrugated beam used for the changeover from a tri-beam road safety barrier system to a W-beam road safety barrier system.
- W-beam: The double corrugated beam component of a public domain non-rigid road safety barrier system.
- RMS- Roads and Maritime Services.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.

Documents
Submit the following for approval:

- Drawings:
  - Set out details
  - As built drawings
- Materials:
  - Steel.
  - Wire rope safety barrier systems.
  - Plastic.
- Manuals: Installation and maintenance manuals for all proprietary barrier and end treatment systems used in the works.

1.7 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Item/Clause title</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Steel</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificates of compliance</td>
<td>Provide documentary evidence of conformity of steel components</td>
<td>1 week prior to erection</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Protective treatment</td>
<td>Provide manufacturers certificate of compliance for galvanising</td>
<td>1 week prior to erection</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Wire rope safety barrier systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proprietary Item</td>
<td>Submit compliance certification</td>
<td>1 week prior to erection</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

Existing underground services

| Location | Locate services underground | 5 working days prior to erection | Superintendent |

Establishment
<table>
<thead>
<tr>
<th>Method statement</th>
<th>Process description for the installation of road safety barrier systems</th>
<th>1 week prior to erection</th>
<th>Superintendent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of barriers</td>
<td>Set out to drawings or as directed</td>
<td>2 working days prior to erection</td>
<td>Superintendent</td>
</tr>
<tr>
<td>End treatment of road safety barriers</td>
<td>MELT</td>
<td>Submit alternative MELT locations</td>
<td>1 week prior to ordering</td>
</tr>
<tr>
<td>Installation of wire rope safety barrier systems</td>
<td>Manufacturers published requirements</td>
<td>Submit tension certificates and testing</td>
<td>Same day as tensioning</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table – On-site activities**

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sequence of construction</td>
<td>Erection after pavement activities</td>
<td>1 week before installation – progressive</td>
</tr>
<tr>
<td>Alternative method of setting posts</td>
<td>Alternative method due to obstructions</td>
<td>1 week before setting posts</td>
</tr>
<tr>
<td>Erection of steel posts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driving equipment</td>
<td>Equipment and procedure for erection</td>
<td>1 week before installation</td>
</tr>
<tr>
<td>Damage to posts</td>
<td>Assessment by Superintendent for replacement</td>
<td>3 working days before removal of damaged post</td>
</tr>
<tr>
<td>Erection of road safety barrier systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive damage to rails</td>
<td>Assessment and rejection by Superintendent</td>
<td>1 working day after perceived damage</td>
</tr>
</tbody>
</table>

2 **PRE-CONSTRUCTION PLANNING**

2.1 **CERTIFICATES OF COMPLIANCE**

Certificates of compliance

Certificates of compliance: Provide certificates from a NATA registered laboratory. All phases of any particular test to be performed at one laboratory. All relevant test results to accompany the Certificate and be within twelve months of the submission date.

2.2 **SCHEDULING**

Program of works

Requirement: Program the works as follows:

- Plan set out procedure and document.
- Identify underground services and submit any alternatives required for post re-location.
- Plan proprietary products and program availability.
3 MATERIALS

3.1 STEEL

Certificates of compliance
Certificates of compliance: Do not erect steel road safety barrier components until the Contractor has produced documentary evidence that the steel components conform to the requirements of this worksection. This is a HOLD POINT.

Quality
Standard: W-beam and Thrie beam elements to AS/NZS 1594.
Steel components: Supply all steel components for public domain non-rigid road safety barrier systems, W-beam and Thrie-beam, to AS/NZS 3845 and of the type shown on the Drawings.
Flat washers: To AS 1237.1 and AS 1237.2.
Curving steel rail: Factory curved to conform with drawings. Carry out curving so that the galvanizing is not damaged.

Protective treatment
Treatment and galvanising: Unless otherwise stated for a specific proprietary safety barrier system or device, treat all surfaces of all ferrous metal components including posts, block out pieces, rail elements, anchor plates, connectors and terminal pieces after fabrication to AS 1627.4 or AS 1627.5 and finish by hot-dip galvanizing to AS 4680. Galvanize all ferrous bolts, nuts, and washers to AS 1214, unless otherwise specified as high strength bolts.
Certificate of compliance: For galvanized steel components provide a manufacturers certificate of compliance certifying that the zinc coating mass conforms to AS/NZS 4680 or, for components of proprietary safety barrier system's or devices, to the manufacturer’s recommendations. This is a HOLD POINT.

W-beam and Thrie-beam barriers
Standard: To AS/NZS 3845.

Storage
Protection: Store all materials, whether fabricated or not, so that damage and corrosion are prevented as follows:
- Store at least 200 mm above ground on platforms, slabs or other supports.
- Storage to prevent 'white rust' from freshly galvanised material.
Rejection: Rusted or bent or damaged steel will be rejected.

3.2 RESERVE

3.3 WIRE ROPE SAFETY BARRIER SYSTEMS

Proprietary Item
Conformance: Supply tensioned wire rope barrier systems as shown in the drawings.
Certification: Submit compliance certification by the manufacturer that the proposed wire rope barrier system meets all specified criteria. This is a HOLD POINT.

3.4 PLASTIC

General
Standard: Retroreflective materials to AS 1906.
Other items: Other plastic components to comply with the manufacturer’s recommendations.

4 EXECUTION

4.1 EXISTING UNDERGROUND SERVICES

Location
Services laid in proximity to the barrier system: Locate prior to placement of footings and protect services from damage. This is a HOLD POINT.
Location: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, for locating underground pipe and cables (possible within two working days). See www.1100.com.au.
4.2 PROVISION FOR TRAFFIC

General
Requirement: To 1101 Control of traffic.
Material stacks: Locate any temporary stacks of new or surplus material associated with the works clear of the traffic flow and behind the line of the safety barrier system being removed, under construction or for construction.
Works program: Manage the sequence for construction to ensure that there are no traffic hazards or safety issues for road users. This includes exposed ends of barriers and when leaving partially completed works at the end of the day.

4.3 QUALITY REQUIREMENTS

General
Standard: Construct non-rigid road safety barrier to AS/NZS 3845 except where explicit departures are shown on the drawings.
Waste: Remove all waste material from the site. Burning, burial or other disposal of waste material on site is not permitted.

4.4 ESTABLISHMENT

Sequence of construction
General: Erect road safety barriers after the construction of the base on concrete pavements and after the placing of the initial layer of asphaltic concrete or sprayed seal on a flexible pavement, unless otherwise approved. This is a WITNESS POINT.
Method statement
Submit: Prior to the installation of any road safety barrier system, submit a process description for the installation of road safety barrier systems. This is a HOLD POINT.
Location of barriers
Set out: Locate all road safety barriers and terminal sections to conform with the drawings or as directed by the Superintendent. Peg or paint mark the start and finish points and line of safety barrier, transitions and terminals including the line of flare if applicable. This is a HOLD POINT.
Post accuracy: Stand posts vertically and space so that no post movement is necessary to align holes or for any other reason when the safety barrier is erected.

Alternative methods of setting posts
Post depths: Set the posts to the full depth as shown on the drawings.
Alternative: If this is not possible due to the presence of an underground obstruction, submit an alternative method of setting the posts prior to carrying out the works. This is a WITNESS POINT.

4.5 ERECTION OF STEEL POSTS

Positioning of posts
Location: As shown on the drawings.
Top of the posts: To AS/NZS 3845 unless otherwise shown on the drawings.
Level of the posts: On terminal ends, level the posts to conform to the extended crossfall of the main pavement unless otherwise shown on the drawings.
Tolerance: Line the tops of posts within ± 20 mm of the heights specified. Ensure a smooth line both horizontally and vertically.

Foundation and testing
Foundations: Erect steel posts by driving, or by other means as directed, to AS/NZS 3845.
Open section: Point the open section of the post in the same direction as adjacent traffic.
Post holes: Compact the bottom of the holes to achieve the same density as the surrounding soil. Support the posts true to line and level whilst the holes are backfilled with clean, well graded, non-cementitious sub-base or base course granular material and compact to achieve the same density as the surrounding material.
Ground tolerance: 3 mm maximum movement in any direction when force tested to AS/NZS 3845.

Driving equipment
Equipment: Submit proposed details of driving equipment and helmet for driving steel posts and procedure to prevent damage to posts if installing by driving, for approval. This is a WITNESS POINT.
Damage to posts
Acceptable condition: No obvious deformation as a result of driving.
Repairs: Repair any damage that occurs to the posts within 24 hours using an organic zinc-rich primer to conform with the repair requirements of Clause 8 of AS/NZS 4680.
Rejected posts: Replace any post deemed excessively damaged and rejected by the Superintendent. This is a WITNESS POINT.

4.6 RESERVE

4.7 ERECTION OF ROAD SAFETY BARRIER RAILS

Blockouts, rail laps and stiffening pieces
Blockouts: Erect steel blockout pieces with the open section pointing in the same direction as adjacent traffic.
Rail laps: Arrange all rail laps in the same direction as adjacent traffic so that approach rail ends are not exposed to traffic.
Stiffening pieces: 300 mm long, on intermediate posts.

Minor damage to galvanising
Protection: Handle and erect road safety barrier rails and blockout pieces to prevent damage to the galvanising.
Repairs: Repair any minor damage to the galvanising within 24 hours using an organic zinc-rich primer to conform with the repair requirements of Clause 8 of AS/NZS 4680.

Excessive damage to rails or blockout pieces
Rejected: Replace any road safety barrier rails or blockout pieces deemed excessively damaged and rejected by the Superintendent. This is a WITNESS POINT.

Erection procedure
Initial tightening: Tighten road safety barrier rail attachment bolts and splice bolts sufficiently to erect the barrier.
Levelling: Make adjustments to the rails using the slotted holes provided to produce a smooth regular line, free of any kinks or bumps.
Top of rails: Overall line of the top of the safety barrier rails to conform with the vertical alignment of the road pavement.

Splice bolt tightening
Tightening: When the alignment both vertically and horizontally is obtained fully tighten the splice bolts. The bolt head (not the shoulder) must be in full bearing with the rail.

4.8 END TREATMENT OF ROAD SAFETY BARRIERS

Leading, trailing terminals
Locations: At both approach and departure ends of the road safety barrier, as detailed on the drawings.

Terminal sections
Locations: The approach and departure ends of double sided road safety barriers, as detailed on the drawings.

MELT
Locations: At approach end locations of road safety barriers as shown on the drawings.
Variation: Where the departure end of a road safety barrier is within the clear zone of opposing traffic, construct a MELT in place of a trailing terminal section. Submit locations prior to ordering. This is a HOLD POINT.

Double sided safety barrier
Terminal sections: Locate terminal sections at the approach and departure ends of double sided road safety barriers as detailed on the drawings.

Connections to rigid barriers
Construction details: Connect non-rigid road safety barrier connections to rigid road safety barriers or bridge parapets as detailed on the drawings and specified in 1163 Rigid road safety barrier systems.
4.9 INSTALLATION OF WIRE ROPE SAFETY BARRIER SYSTEMS

Manufacturer's published requirements
Installation: Install Wire Rope safety barrier systems to conform with the manufacturers specified requirements.
Concrete footings: Install all posts in concrete footings with suitable sockets including covers to the sockets. Do not use driven posts.
Intermediate blocks or tension bays: Install intermediate blocks or tension bays at the dimensions recommended by the manufacturer.
Footings: Installation to conform with the following:
- The manufacturers published requirements.
- Uniform shape.
- Unless specified otherwise by the manufacturer, no protrusion above the finished surface level by more than 20 mm.

Wire rope tension: Submit certification that the wire rope has been tensioned to conform with the manufacturer's published requirements. The certificate must include the date, time, ambient air temperature, tension force and signature and name of the individual managing the work at the time. This is a HOLD POINT.

4.10 DELINEATORS
Fixing
Standard: To AS 1906.2.
Locations: Fix delineators with brackets to the road safety barrier, to the details and at the locations shown on the drawings beginning at the first post and then to conform with the Table Location of delineators.

<table>
<thead>
<tr>
<th>Radius of curve (m)</th>
<th>Spacing of reflectors on barrier every</th>
</tr>
</thead>
<tbody>
<tr>
<td>30–90</td>
<td>3rd post</td>
</tr>
<tr>
<td>90–180</td>
<td>5th post</td>
</tr>
<tr>
<td>180–275</td>
<td>8th post</td>
</tr>
<tr>
<td>275–365</td>
<td>11th post</td>
</tr>
<tr>
<td>over 365 (including straight road)</td>
<td>16th post</td>
</tr>
</tbody>
</table>

Arrangement and colour
Direction of traffic: Arrange the delineators so that drivers approaching from either direction will see only red reflectors on their left side, and white reflectors on their right.

4.11 AS BUILT HANOVER REQUIREMENTS

General
Manuals: Provide installation and maintenance manuals for all proprietary barrier and end treatment systems used in the works.
As built drawings: Include:
- Drawings.
- Proprietary safety barrier systems or end treatments: Detail the system, name and post spacing.
- Non proprietary end treatments: Detail the end treatment name and post types. Limits and tolerances

Application
Summary: The limits and tolerances applicable to this worksection are summarised in Summary of limits and tolerances table.

Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/ subclause</th>
</tr>
</thead>
</table>

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### 5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

#### 5.1 MEASUREMENT

**General**

Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1194.1 to 1194.7 inclusive.

Lump Sum prices: Not acceptable.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

**Methodology**

The following methodology will be applied for measurement and payment:

- **Concrete footings for timber posts**: To conform with this worksection and not 0319 Minor concrete works.

- **Miscellaneous minor concrete work** not included in Pay items in this worksection: To conform with Pay items in 0319 Minor concrete works.

- **Traffic control**: To conform with 0319 Minor concrete works.

#### 5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay Items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1194.1 Single sided road safety barrier</td>
<td>Linear metre. - The distance measured along the centre line of the rail, centre to centre of posts, excluding terminal sections and connectors to rigid safety barriers or bridge parapets.</td>
<td>All costs associated with the supply of components, fixings and activities associated with the erection of each type of road safety barrier.</td>
</tr>
<tr>
<td>- 1194.1(1) Single W-beam.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.1(2) Nested W-beam.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.1(3) Single Thrie-beam.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.1(4) Nested Thrie-beam.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.1(6) Nested Modified Blockout Thrie-beam.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.1(7) Single W-Thrie-beam Transition.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.1(8) Nested W-Thrie-beam Transition.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1194.2 Modified eccentric loader terminal (MELT)</td>
<td>Each - Each MELT section supplied and erected</td>
<td>All costs associated with supply and erection of MELTS as detailed on the drawings.</td>
</tr>
<tr>
<td>1194.3 Terminal section</td>
<td>Each - Each terminal section supplied and erected</td>
<td>All costs associated with supply and erection of terminals as detailed on the drawings.</td>
</tr>
<tr>
<td>- 1194.3(1) Leading Terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.3(2) Trailing Terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1194.4 Connectors to rigid road safety barriers (RSB) or bridge parapet</td>
<td>Each - Each connector supplied and erected</td>
<td>All costs associated with supply and erection of RSB connectors as detailed on the drawings excluding the anchorage.</td>
</tr>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>- 1194.4(1) W-beam to RSB</td>
<td></td>
<td>assemblies cast into the rigid road safety barrier or bridge parapet.</td>
</tr>
<tr>
<td>- 1194.4(2) W-beam to Thrie-beam to RSB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.4(3) Thrie-beam to RSB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1194.5 Delineator brackets</td>
<td>Each</td>
<td>All costs associated with s &amp; e delineator brackets.</td>
</tr>
<tr>
<td>1194.6 Double sided road safety barrier</td>
<td>Linear metre.</td>
<td>All costs associated with the supply of components, fixings and the erection of each type of road safety barrier.</td>
</tr>
<tr>
<td>- 1194.6(1) Single W-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.6(2) Nested W-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.6(3) Single Thrie-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.6(4) Nested Thrie-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.6(5) Single Modified Blockout Thrie-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.6(6) Nested Modified Blockout Thrie-beam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1194.6(7) Single W-Thrie-beam Transition</td>
<td>'Each' terminal section supplied and erected</td>
<td></td>
</tr>
<tr>
<td>- 1194.6(8) Nested W-Thrie-beam Transition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1194.7 Double sided road safety barrier terminal section</td>
<td>'Each' terminal section supplied and erected</td>
<td>All costs associated with the supply and erection of double sided road safety barrier terminal sections as detailed on the drawings.</td>
</tr>
</tbody>
</table>
1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide boundary fences for road reserves, as documented.

Performance
Requirements: Conform with drawings, this worksection, directions by the Superintendent all to conform with 0161 Quality (Construction).

Design
Designer: Suitably qualified to RP Eng/CP Eng standard to authorise design by signature.

Authority requirements: As required by the Conditions of Development Consent.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1111 Clearing and grubbing.
- 1192 Signposting.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used

AS 1074 Steel tubes and tubulars for ordinary service.
AS 1111 ISO Metric hexagon bolts and screws – Product grade C.
AS 1111.1 Bolts.
AS 1111.2 Screws.
AS 1112 – Various ISO Metric hexagon nuts.
AS/NZS 1163 Structural steel – Hollow sections.
AS 1214 Hot-dip galvanised coatings on threaded fasteners (ISO metric coarse thread series).
AS 1237 Plain washers for metric bolts, screws and nuts for general purposes.
AS 1237.1 General plan.
AS 1237.2 Tolerances.
AS 1289 Methods of testing soils for engineering purposes.
AS 1289.5.6.1 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material.
AS/NZS 1390 Cup head bolts with ISO metric coarse pitch threads.
AS 1720 – various Timber structures.
AS 1725 Chain-link fabric security fencing and gates.
AS 1725.1 Security fences and gates – General requirements.
AS 1725.2 Tennis court fencing – Commercial.
AS 1725.3 Tennis court fencing – Private/residential.
AS 1725.4 Cricket net fencing enclosures.
AS 1725.5 Sports ground fencing – General requirements.
AS 1742 Manual of uniform traffic control devices.
AS 1742.2 Traffic control devices for general use.
AS 2423  Coated steel wire fencing products for terrestrial, aquatic and general use.
AS 3600  Concrete structures.
AS/NZS 3750.9  Paints for steel structures – organic zinc – rich primer.
AS/NZS 4680  Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.
AS/NZS 4792  Hot-dip galvanised (zinc) coatings on ferrous hollow sections applied by a continuous or a specialised process.

1.4 STANDARDS

General
Standard: To AS 1725.1.
Security fences and gates: To 1725.1.
Tennis courts: To AS 1725.2 and AS 1725.3.
Cricket court: To AS 1725.4.
Sports ground: To AS 1725.5.

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

Approvals
Execution: Written approval for access to properties.
Materials: Posts, wire products, concrete, timber, gates.

1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause title / Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRE-CONSTRUCTION PLANNING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material selection – Material approval</td>
<td>Submit source, type, Certificate of compliance and manufacturer for each type of material</td>
<td>One week before ordering each type</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- General</td>
<td>Confirm approval for access and work on adjacent property</td>
<td>One week before commencing site work</td>
<td>Superintendent</td>
</tr>
<tr>
<td>- Temporary fencing</td>
<td>No fence to be removed where risk of egress or ingress of stock</td>
<td>One week before commencing site work</td>
<td>Superintendent</td>
</tr>
<tr>
<td>- Temporary fencing</td>
<td>Maintain rabbit-proof fence at night and weekends</td>
<td>During works</td>
<td>Superintendent</td>
</tr>
<tr>
<td>- Clearing and grubbing</td>
<td>Confirm approval for tree removal</td>
<td>One week before next activity</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>Erection of posts</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- General</td>
<td>Dial before you dig to check for underground services</td>
<td>3 working days prior to commencing digging or driving</td>
<td>Superintendent</td>
</tr>
<tr>
<td>- Depth of posts</td>
<td>Method of installing and proposed type of posts to</td>
<td>One week before manufacture or order</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

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2 PRE-CONSTRUCTION PLANNING

2.1 MATERIAL SELECTION

Material approval
Submit: For each type of material required for supply, submit details of the source, manufacturer and type as applicable including the certificate of compliance. No material is to be delivered or used in the works until approved. This is a HOLD POINT.

Certificate of compliance
General: Identify the item, record the product certification, inspection or test records that verify conformance.

2.2 PROGRAMMING

General
- Schedule components and materials to be supplied.
- Program the construction to conform to contract requirements.
- Obtain approvals for access affecting work adjacent to the road reserve.
3	MATERIALS

3.1	STEEL POSTS

Steel tubes
Standard: To AS 1725.1 and AS/NZS 1163 and galvanized to AS/NZS 4792.
Type: Medium-quality pipe tube grade (C250L0) to the dimensions as shown on the drawings.

Fence posts
Standard: To AS 1725.1.
Type: Medium – quality.
Splicing: Any splicing required must be butt welded and located in the concrete not less than 150 mm below ground level.
Welding: Clean and paint all welding with a cold galvanizing compound (zinc rich paint). This is a WITNESS POINT.
Post extensions: To AS 1725.1 for barbed wire attachment.
Connections: If connections are not welded and are subjected to movement, protect the galvanised coatings from scratching caused by the connecting members.
Top caps: Fit each post with a galvanised steel cap to prevent the ingress of water.

Star posts (Rural fencing)
Type: ‘STAR’ pattern (‘Y’ bar section) drilled to suit the spacing of the wires shown on the drawing(s).
Protection: Black varnished or hot-dip galvanized to AS/NZS 4680.
Total weight: Total weight of 290 posts each 1.65 m long must be at least one (1) tonne.

Pipe rail for pipe rail fencing
Standard: To AS 1725.1.
Type:
- Nominal diameter: 32 mm.
- Outside diameter: 42.4 mm
- Alternatively, as shown on the drawings.
Joints: Only permitted for continuous top rail fencing greater than 6000 mm intervals. Tight fitting internal swagged or external sleeve joints or screwed and socket joints or butted together centrally over post within the fitting.

Strainer posts
Standard: To AS 1074 and galvanized to AS/NZS 4680.
Type: Medium grade tube.
Dimensions:
- Minimum diameter: 150 mm.
- Minimum wall thickness: 4 mm.
- Submit any alternate sizing. This is a WITNESS POINT.
Holes: Provide a set of 12 mm holes to suit the spacing of the wires shown on the drawings.

Intermediate posts
Standard: To AS 1074 and galvanized to AS 4680.
Type: Medium grade tube.
Dimensions:
- Minimum diameter: 150 mm.
- Minimum wall thickness: 4 mm.
- Submit any alternate sizing. This is a WITNESS POINT.

3.2	CHAIN WIRE AND WIRE NETTING

General
Standard: To AS 1725.1 and AS 2423.
Zinc coating: Uniform, continuous, free from imperfections, thoroughly adherent and applied to the wire before the mesh is woven.
Weight: Zinc coating weight ≥290 g/m² of wire surface.
PVC coating: Coated in black PVC after galvanizing where specified.

**Wire netting used in rabbit-proof fencing**
Type: 105 x 4 x 1.4 (1.065 m wide, 38 mm mesh, 1.40 mm diameter wire) unless documented elsewhere.

**Wire netting used in gullies and creek crossings**
Type: 90 x 5 x 1.6 (0.965 m wide, 51 mm mesh, 1.60 mm diameter wire) unless documented elsewhere.

**Wire netting standard use**
Type: 105 x 4 x 1.4 (1.05 m wide, 40 mm mesh, 1.40 mm diameter wire) unless documented elsewhere.

**Chain wire used in Manproof fencing**
Type: 15 m/1800 x 50 x 3.15/W10Z/HG/KK/HD (rolled length, width, pitch, diameter, metallic coating grade, protective coating system code, selvedge type, service duty) unless documented elsewhere.

### 3.3 Gates

**General**
Standard: To AS 1725.1 and hot dip galvanized to AS/NZS 4680.
Type: Galvanized tubular steel 3.6 m wide, 1.5 m or 1.2 m (as documented to match the height of the fence) in height.
Fittings: Substantial hinges, catch, drop bolts and locking chains unless otherwise shown on the drawings or as directed. This is a **WITNESS POINT**.
Joints: Fully welded fillet welds, minimum 6 mm exposed surface width and cleaned.

**Rabbit proofing**
Gates: Rabbit-proof mesh to a height of at least 900 mm above ground level.

### 3.4 Reinforced Concrete Posts

**Precast strainer posts**
Standard: To AS 3600.
Dimensions: 150 x 150 mm square in section and heights as shown on the drawings.
Holes in posts: 12 mm diameter holes to suit the spacing of the wires shown on the drawings.
Reinforcing steel: Reinforce longitudinally with at least 4 bars of 12 mm diameter, also suitable stirrup reinforcement to control diagonal cracking. As shown on the drawings.
Cover: Longitudinal reinforcement minimum cover = 20 mm. End cover on reinforcement = 20 mm.
Concrete strength: Minimum 28 day compressive strength of 32 MPa.

**Precast intermediate posts**
Dimensions: 100 x 100 mm square section and heights shown on drawings.
Reinforcing steel: Longitudinal reinforcing bars may be 9 mm diameter.
Similar: Cover, concrete strength and holes as for strainer posts.

### 3.5 Prestressed Concrete Posts

**Strainer posts**
Tendons: Provide at least 2 high tensile tendons tensioned to conform with the drawings.
Cover: At least 20 mm minimum longitudinal cover.
Cross section: Rectangular section 150 x 100 mm or as shown on the drawings.
Concrete: Minimum 28 day compressive strength of 32 MPa.
Grooves for wire: At least 5 mm deep and 5 mm wide at the surface of the post and to suit the spacing of the wires shown on the drawings.

**Intermediate posts**
Tendons: Provide a single high tensile tendon tensioned to conform with the drawings.
Cross section: 100 x 60 mm rectangular.
Grooves: At least 5 mm deep and 10 mm wide at the surface of the post and to suit the wires shown on the drawings.
3.6 TREATED TIMBER POSTS AND BRACES

General
Hardwood: To AS 2082.
Sawn timber: To AS 2658 and AS 1720 Grade F5.
Treatment: To AS 1604 hazard class H4, containing no mixtures or compounds of the elements chromium and arsenic.
Strainer posts, intermediate posts and bracing: As shown on drawings.

3.7 WIRES

Plain wire
Standard: To AS 2423.
Type: Low tensile fencing wire (Class W02 or greater, with coating type Z, ZA or E).
Diameters: As shown on the drawings.

High tensile plain wire
Standard: To AS 2423.
Type: High tensile fencing (Class W02 or greater, with coating type Z, ZA or E).
Diameters: As shown on the drawings.

PVC coated wire
Core wire: As per plain or high tensile wire above and as specified on the drawings.
Standard: Apply coating to AS 2423.

Barbed wire
Standard: To AS 2423.
Type: Low tensile barbing wire 2.5 mm diameter galvanized drawn annealed steel wire (Class W02 or greater with coating type Z, ZA or E), with clusters of four barbs spaced between 75 and 110 mm.
Alternative: High tensile barbed wire (Class W02 or greater with coating type Z, ZA or E) of 1.6 mm diameter with clusters of barbs spaced between 75 and 110 mm.

Cable wire
Type: Three pairs of 2 x 3.15 mm galvanized iron wire tightly twisted around posts.
Location: As shown in the drawings.

Tie wire
Standard: To AS 2423.
Type: Low tensile (Class W02 or greater, with coating type Z, ZA or E) wire, 2 mm diameter galvanized wire.

3.8 MISCELLANEOUS HARDWARE

General
Standards: Conform to the following:
- Bolts and screws: To AS/NZS 1111.
- Cup head bolts: To AS/NZS 1390.
- Hexagon nuts: To AS 1112.
- Plain washers: To AS 1237.1 and AS 1237.2.
- Hot-dipped Galvanized threaded fasteners: To AS 1214.
Type: Commercial grade bolts, nuts and washers.

3.9 CONCRETE BACKFILLING

Backfilling
Concrete strength: 20 MPa minimum 28 day compressive strength to conform with the requirements of 0319 Minor concrete works.
4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 ESTABLISHMENT

General
Access: Liaise with property owners, Council and Superintendent to get written approval to access properties for the activities of clearing, fence construction, removal and disposal of materials. This is a HOLD POINT.

Damage: The Developer/ Council Contractor will be held responsible for any loss, damage, or injury to buildings, goods, crops, livestock, property of any kind or persons due to negligence by the Developer/ Council Contractor This is a WITNESS POINT.

Quality: Erect all fencing in a workmanlike manner, a sound, strong and neat appearance when complete.

Uniform grade: If minor irregularities occur in the ground levels, the vertical alignment of the fence is not to follow these irregularities. The fence must align to a uniform grade between definite changes in the natural slope of the ground.

Survey pegs: Leave all survey pegs undisturbed and adjust the post spacing where necessary to avoid pegs.

Stock proof: Maintain the fencing at all times in a condition secure against movement of stock, and take all necessary precautions to prevent people or stock from injury due to fencing activities.

Removal of existing fencing
Location: Remove existing fencing as shown on the drawings.

Posts in rock: Seek approval to neatly cut off at ground level. This is a WITNESS POINT.

Backfilling of old holes: Backfill all holes left after removal of old fence and compact firmly in layers of maximum depth 150 mm.

Rabbit-proof fence: Replace any buried netting with similar fencing and remove all traces of the old netting.

Temporary fencing
Stock fence: If there is a risk of egress or ingress of stock, do not remove fencing. The Developer to replace automatically. This is a HOLD POINT.

Type: Temporary fencing as documented and shown on the drawings for the new fencing. Use the same erection methods as for the final fencing.

Removal and disposal of surplus material and rubbish
Contractor’s responsibility: Remove or otherwise dispose of all surplus material, offcuts, timber, roots and other debris resulting from the fencing contract to the satisfaction of the Superintendent. This is a WITNESS POINT.

Fire damage: Do not burn combustible materials.

Clearing and grubbing
Clearing: Clear a width of one metre on either side of the fence line, and for the full length of the line.
Remove: All logs, boulders, stumps, roots, undergrowth and rubbish and dispose in conformance with 1111 Clearing and grubbing except where directed otherwise.

Trees: Remove trees within this area only as directed by the Superintendent and approved by Council. This is a HOLD POINT.

Survey marks: Protect survey marks during the clearing operations.

Trees retained: If trees on or adjacent to the fence line are to be retained, arrange the fencing at the trees as directed. This is a WITNESS POINT.

Trees on fence line: Do not strain wire around or against any trees left in the fence line. Provide strainer posts on both sides of each tree.

Damage: Undertake clearing operations to ensure no damage to trees and native shrubs outside the limits of clearing specified.
Connections to existing fences
Submit: A proposal for connection arrangement where new fencing intersects with existing fencing. This is a HOLD POINT.

4.3 ERECTION OF POSTS

General
Steep locations: Erect all posts vertically except in unusually steep locations where posts may be erected perpendicular to the surface of the ground.

Contact: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, of locating underground pipe and cables (possible within two working days). See www.1100.com.au.
Locations: Obtain locations of water, sewer, stormwater, gas, electricity and telephone services. The Utility Authorities: In addition contact names listed in 013B General Requirements (Construction) to verify the location of services. This is a HOLD POINT.
Concrete for footings and base strips: Crown the top surface at each post to shed water away from the post.

Depth of posts
Method: Submit installation method and proposed type of post for approval. This is a HOLD POINT.
Sinking depths: Posts must be sunk or driven to the Posts depth table.

<table>
<thead>
<tr>
<th>Posts depth table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of post</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Concrete strainer posts</td>
</tr>
<tr>
<td>Concrete intermediate posts</td>
</tr>
<tr>
<td>Treated timber strainer posts</td>
</tr>
<tr>
<td>Treated timber intermediate posts</td>
</tr>
<tr>
<td>Galvanised steel strainer posts</td>
</tr>
<tr>
<td>Galvanised steel intermediate posts</td>
</tr>
<tr>
<td>Other steel posts</td>
</tr>
</tbody>
</table>

* NOTE Permitted only in cases where posts of the correct length are supplied, otherwise the depth of sinking must be the same as for earth.

Damaged posts: If a post becomes significantly damaged or cannot be driven vertically, remove the post. Erect the same post, if undamaged, or a new post into neatly cut holes backfilled to the full depth with earth (where sunk in earth) or cement mortar or concrete (20 MPa) where in rock.

Posts sunk in earth: If posts are not driven into the earth, the diameter of hole must permit sufficient compaction of the backfill. Backfill earth in layers of 150 mm maximum depth for the full depth of the hole ensuring the relative compaction of the rammed material equals the original undisturbed ground.
Rock holes: Provide posts erected in rock holes with sufficient diameter to permit tight refilling with cement mortar or concrete.

Diameter: 250 mm unless otherwise shown on the drawings. This is a WITNESS POINT.

Strainer posts
Locations: Provide strainer posts at ends of fencing, angles, intersections with other fencing, gates and at intermediate points.
Distances between strainer posts: 120 metres maximum.
Bracing in one direction: At the ends of fencing and at gates.
Bracing in two direction: At angles in the fence line, abrupt changes of grade and at intermediate points.
Drawings: Other strainer post arrangements as shown on the drawings.
Bracing: Conform to the following:
- Timber posts: Round timber as shown on the drawings.
- Other than timber posts: Medium weight galvanised steel tube to dimensions shown on the drawings.
Distance: Between intermediate point strainer posts < 120 m except in the case of fencing for the retention of cattle < 90 m.

**Reinforced concrete posts**

Foundation: Erect in neatly cut holes sunk in earth, or in rock where this is encountered.

Strainer posts: Backfill to the full depth of the hole with concrete of minimum compressive strength of 20 MPa at 28 days to the requirements of 0319 Minor concrete works.

Intermediate posts: Backfill to the full depth of the hole with earth, where post is sunk in earth or with cement or concrete (20MPa at 28 days) where the post is sunk in rock.

Cement mortar: 1 cement : 2 sand.

**Cutting**: Cutting concrete posts is not permitted. To take advantage of the reduced sinking depth for rock, provide posts manufactured in shorter lengths to suit the depth of sinking.

**Prestressed concrete posts**

Erection: Either as for the reinforced concrete posts or driven in earth using a suitable post driver to hold the post vertical and in position during driving. Driving prestressed posts is not permitted except where shown on the drawings.

Protect whilst driving: Provide a steel cap with a plywood cushion not less than 12 mm thick to protect the top of the post during driving.

**Cutting**: Cutting concrete posts is not permitted. To take advantage of the reduced sinking depth for rock, provide posts manufactured in shorter lengths to suit the depth of sinking.

**Steel posts**

Driving: If not erected in rock, drive steel posts with suitable driving equipment taking care not to damage the tops of the posts during driving.

Damage to protection: Repair any damage to protective coating using an organic zinc-rich primer in conformance with AS 3750.9.

Rock: Erect posts in neatly cut holes and backfill to the full depth of the hole with cement mortar or 20 MPa concrete.

**Treated timber posts**

Erect: Similar to reinforced concrete posts or driven in earth using a suitable post driver. Ensure no damage to the post during driving.

**Stiff earth**: Drive posts in to holes of a diameter 50 mm less than the nominal maximum post diameter. Drive posts with the small diameter end down. If not driven, erect with butt end down.

4.4 ERECTION OF WIRES

**Installation**

Placement: Place all wires as shown on the drawings.

Side fixed wires: Place on the property owners side of the posts.

Fasten and strain: Securely fasten and strain wires to the following nominal tension between strainer posts using a wire strainer and gauge.

**Table for wire tensions**

<table>
<thead>
<tr>
<th>Wire diameter (mm)</th>
<th>Type</th>
<th>Tension (kN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td>Plain wire</td>
<td>1.8</td>
</tr>
<tr>
<td>2.5</td>
<td>H.T Plain wire</td>
<td>1.3</td>
</tr>
<tr>
<td>2.5</td>
<td>Barbed wire – L.T</td>
<td>1.3</td>
</tr>
<tr>
<td>1.6</td>
<td>Barbed wire – H.T</td>
<td>1.3</td>
</tr>
</tbody>
</table>

Strainer posts: Fix plain and barbed wire at strainer posts as shown on the drawings.

Secure end: Wrap wire at least four times around the tension side of the line.

Top strand: Tie barbed wire in position at the top of reinforced concrete intermediate posts and steel posts as shown on drawings. For timber posts fix to the top of the post using a galvanised staple minimum 40 mm long.

Fixing wires: Fix wires to the posts as shown on the drawings or by using proprietary galvanised fastening clips as approved. This is a HOLD POINT.
Prestressed concrete: Securely fasten wires so that they seat firmly in the grooves provided on the side of the posts.

Tie wire: Stretch tight and fit snugly against the side of the post to prevent movement of the wire. Wrap the ends of the tie wire at least twice around the line wire and neatly cut off. Form all joints in wire as figure-of-eight knots as shown on the drawings.

4.5 ERECTION OF NETTING AND CHAIN WIRE MESH

Netting
Side: Erect wire netting on the same side of the fence as the line wire.
Type: As shown on the drawings.
Attachment: Attach to the fence using tie wire or fixing clips. Twist each tie wire twice around the fence wire and neatly cut off the ends.
Straining netting: Loosely tie the netting to the fence wires then carefully strain without distorting or breaking the mesh. Tie to the wires immediately on each side of every post at intervals not exceeding 1.0 m.

Chain wire mesh
Location: Where documented, or shown on the drawings.
Side: Erect chain wire mesh on the outside of the posts.
Fastened: With two turns of the wire to each cable wire on both sides of each post and at intervals of not more than 900 mm between posts and to each post midway between cable wires.

4.6 GATES

Erection
Swing: Erect gates so that they swing away from the road.
Single gates: Supply single gates unless otherwise shown on the drawings or as directed. This is a WITNESS POINT.
Level surface: At the location of gates and swing area, level the surface nearly horizontal.
Hanging: Hang the gates and provide with connections and fittings as documented or shown on the drawings.

4.7 RESERVE

4.8 STOCK GRIDS

General
Location: Where shown on the drawings, or as directed. This is a HOLD POINT.
Bedding: Evenly bed the grid base on a continuous layer of 50 mm thick compacted sand or other granular material with a maximum size of 5 mm. Compact bedding material to achieve a density index as determined by AS 1289.5.6.1 of not less than 70%.
Raised abutments: Install grids on raised abutments with approach ramps where possible.
Alternative: Grid may be placed over an excavated pit, in which case adequate drainage must be provided.
Transition: Ensure smooth transition from grid to ground.
Dispose: Dispose of any excavated material.
Single lane grids: No crossfall.
Two lane grids: Each half of the grillage must have a crossfall conforming to the cross fall of the approach road.
Extent of work: The cattle grid construction includes all activities associated with the cattle grid including any adjustments to the fencing as shown on the drawings.
Advance signposting: To AS 1742.2 and 1192 Signposting on each approach to the cattle grid.

4.9 LIMITS AND TOLERANCES

Application
Summary: The limits and tolerances applicable to this work section are summarised in Summary of limits and tolerances table.
Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel posts</td>
<td>Type: Medium quality&lt;br&gt;Star posts: Weight of 290 posts 1.65 m long &gt; 1 tonne&lt;br&gt;Pipe rail: Diameter nominal = 32 mm&lt;br&gt;Strainer posts: Diameter = 150 mm&lt;br&gt;Wall thickness &gt; 4 mm</td>
<td>Materials – Steel posts</td>
</tr>
<tr>
<td>Zinc coating</td>
<td>Zinc coating weight ≥290 g/sq m of wire surface</td>
<td>Materials – Chain wire netting</td>
</tr>
<tr>
<td>Reinforced concrete posts</td>
<td>Concrete strength &gt; 32 MPa at 28 days</td>
<td>Materials – Reinforced concrete posts</td>
</tr>
<tr>
<td>Prestressed Concrete posts</td>
<td>Strainer longitudinal cover &gt; 20 mm&lt;br&gt;Concrete strength &gt; 32 MPa at 28 days</td>
<td>Materials – Prestressed concrete posts</td>
</tr>
<tr>
<td>Depth of posts</td>
<td>See Table Post depth</td>
<td>Erection of posts</td>
</tr>
<tr>
<td>Backfill</td>
<td>Concrete strength &gt; 20 MPa at 28 days</td>
<td>Erection of posts</td>
</tr>
<tr>
<td>Strainer posts</td>
<td>Distance between strainer posts &lt; 120 m&lt;br&gt;Except for cattle retention &lt; 90 m</td>
<td>Erection of posts</td>
</tr>
<tr>
<td>Wires</td>
<td>Table for wire tensions</td>
<td>Erection of wires</td>
</tr>
</tbody>
</table>

5  MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1  MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1195.1 to 1195.4 inclusive.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
- Clearing and grubbing: To conform with this worksection and not 1111 Clearing and grubbing.
- Concrete backfilling and blocks: To conform with this worksection and not 0319 Minor concrete works.
- Signposting: To conform with this worksection and not 1192 Signposting.

5.2  PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1195.1 Supply and erection of boundary fencing</td>
<td>Linear metre of fencing, chain link, stock-proof or rabbit-proof, measured on site</td>
<td>Separate pay items to be shown for each type of fence specified. All costs associated with supply of all materials, the clearing of site, and all activities associated with the erection of the fence, including the levelling of mounds</td>
</tr>
<tr>
<td>Description</td>
<td>Item 1</td>
<td>Item 2</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
</tr>
<tr>
<td>(if required), concreting, the provision of crossings for watercourses and depressions as necessary, flood gates as necessary and the connection of the new fence to existing fence where required together with all types of excavation material encountered during construction work, both earth and rock and the removal and disposal of surplus material and rubbish.</td>
<td>1195.2 Supply &amp; erection of boundary fence gates</td>
<td>'Each' gate erected</td>
</tr>
<tr>
<td>1195.3 Supply &amp; installation of cattle grid</td>
<td>'Each' cattle grid installed</td>
<td>All costs associated with the supply of the cattle grid together with all activities associated with the construction of the cattle grid including bedding, approach ramps, wings, drainage, adjustment to fencing and the provision of signs.</td>
</tr>
<tr>
<td>1195.4 Removal of existing fence</td>
<td>Linear metre of fencing removed as measured on site</td>
<td>All costs associated with all activities associated with the demolition and disposal of the existing fence.</td>
</tr>
</tbody>
</table>
1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide drainage works as a complete system for collecting and carrying stormwater from roadways, open spaces and built-up areas as documented. Include Water Sensitive Urban Design (WSUD) principles as follows:
- Preparation for stormwater drainage construction.
- Temporary drainage during construction.
- Detention or re-use of stormwater.
- Vegetation filtering or water efficient landscaping.
- All work associated with erosion control.

Performance
Requirements: As required by the Conditions of Development Consent.
Precedence: Where any document used in conjunction with this worksection includes technical requirements that conflict with this worksection, the requirements of this worksection take precedence.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0257 Landscape – Roadways and street trees.
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation (Construction).
- 1112 Earthworks (Roadways).
- 1121 Open drains, including kerb and gutter.
- 1352 Pipe drainage.
- 1353 Precast box culverts.
- 1354 Drainage structures.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used
AS 1141 Methods for sampling and testing aggregates
AS 1141.11.1 Particle size distribution - Sieving method
AS 1289 Methods of testing soils for engineering purposes
AS 1289.3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
AS 1289.3.3.1 Soil classification tests - Calculation of the plasticity index of a soil
AS 1289 4.3.1 Soil chemical tests - Determination of the pH value of a soil - Electrometric method
AS 1289 4.4.1 Soil chemical tests - Determination of the electrical resistivity of a soil
Method for sands and granular materials
AS 1289.5.4.1 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1 Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation (Rapid method)
AS/NZS 2566  Buried flexible pipelines
AS/NZS 2566.1  Structural design - Commentary
AS/NZS 2566.2  Installation
AS 3600  Concrete structures
AS/NZS 3725  Design for installation of buried concrete pipes
AS/NZS 3725 Supp 1  Loads on buried concrete pipes - Commentary (Supplement to AS/NZS 3725:2007)
AS 3735  Concrete structures retaining liquids

Other publications
Note: Only the most current standards are to be used
Institute of Public Works Engineering Australia (IPWEA)
IPWEA (NSW)  Specification for the supply of recycled materials for pavements, earthworks and drainage (Greenspec)
NSW Department of Environment and Conservation
Managing urban stormwater – Harvesting and Reuse.

1.4  INTERPRETATIONS

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- D: External diameter of the pipe.
- NATA: National Association of Testing Authority.

Definitions
General: For the purposes of this worksection the following definitions apply:
- Materials: In conformance with relevant worksection.
- Inadequate foundation material: Material beneath or adjacent to the proposed drainage structures which the Superintendent deems to be of insufficient strength to support the structure and loads on the structure, or material whose characteristics the Superintendent deems would adversely affect the performance or construction of the drainage structure.
- Selected fill: Backfill material with known properties and grading placed and compacted in layers.
- Water Sensitive Urban Design (WSUD): Design principles aimed at improving the sustainable management of the urban water cycle. It integrates the planning and design of urban water cycle, water supply, waste water, stormwater and groundwater management, urban design and environmental protection.
- RMS: Roads and Maritime Services.

1.5  SUBMISSIONS

Approval
Submissions: To the Superintendent's approval Council's Engineering Development Officer.

Documents
General: Submit the following for approval:
- Materials: Off-site certificates of components including certificate of the source of the materials used.
- Temporary drainage: Detailed proposals for diversion of existing flow paths.
- Calculations: Survey set out of stormwater works and quantity calculations.
- Work-as-executed drawings: Include stormwater system information sheets and works.
- Components: Pipes and fittings.
- Samples: For conformity testing to relevant standards.
- Technical data: Product information.
- Execution details: Refer to HOLD POINTS.
- Adverse ground conditions: NATA certificate for pH and electrical resistivity of soil tested to AS 1289.4.3.1 and AS 1289.4.4.1.

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### 1.6 HOLD POINTS AND WITNESS POINTS

**Notice**
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

#### HOLD POINTS table

<table>
<thead>
<tr>
<th>Clause title/item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRE-CONSTRUCTION PLANNING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Authority Approvals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporary drainage</td>
<td>Submit details of procedures/devices for approval</td>
<td>2 weeks prior to site commencement</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bedding, support and backfill material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability - Geotechnical NATA test</td>
<td>Submit tests for pH and resistivity</td>
<td>1 week prior to proceeding</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Durability - Test for concentration of impurities</td>
<td>Test for chloride, sulphate and aggressive CO₂</td>
<td>1 week prior to proceeding</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Siting of Culverts - Survey set-out</td>
<td>Submit survey set-out of culvert inlets and outlets for approval</td>
<td>1 week prior to proceeding</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td>Siting of Culverts - Changes by Contractor</td>
<td>Submit proposed changes for approval</td>
<td>1 week prior to proceeding</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td>Excavation near underground services - Public utilities</td>
<td>Obtain approval for adjacent excavation</td>
<td>1 week prior to proceeding</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Excavation near underground services - Contact DIAL BEFORE YOU DIG</td>
<td>Contact DIAL BEFORE YOU DIG</td>
<td>1 week prior to proceeding</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Excavation near underground services - Marking</td>
<td>Submit marking for approval</td>
<td>1 week prior to proceeding</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Construction traffic - Protection measures</td>
<td>Submit certification and verification of protection measures</td>
<td>3 working days</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Excavation for drainage systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Confirmation</td>
<td>Confirm soil type with design</td>
<td>3 working days</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Bedding and backfilling</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncompacted bedding for steel pipes and pipe arches</td>
<td>Submit details for achieving dense bedding zone</td>
<td>1 week</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Water sensitive urban design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landscape and vegetation - Plant</td>
<td>Submit plant selection for a particular area</td>
<td>1 week</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Clause title/Item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------------------------------</td>
<td>-----------------------</td>
<td></td>
</tr>
<tr>
<td>species selection</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### WITNESS POINTS table

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation for drainage systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pipelines</td>
<td>Trench size to AS/NS 3735</td>
<td>3 working days</td>
</tr>
<tr>
<td>Drainage structures other than</td>
<td>Clear widths between structure and wall of</td>
<td>3 working days</td>
</tr>
<tr>
<td>pipes</td>
<td>excavation</td>
<td></td>
</tr>
<tr>
<td>Inadequate foundation material</td>
<td>Identify unsuitable material and provide</td>
<td>3 working days</td>
</tr>
<tr>
<td>- Notice</td>
<td>remedial measures</td>
<td></td>
</tr>
<tr>
<td>Inadequate foundation material</td>
<td>Additional excavation and backfill required</td>
<td>1 week</td>
</tr>
<tr>
<td>- Rock foundation</td>
<td>if rock is encountered at foundation level</td>
<td></td>
</tr>
<tr>
<td>Bedding and backfilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backfilling - In situ concrete</td>
<td>Do not backfill against in situ concrete</td>
<td>2 working days</td>
</tr>
<tr>
<td>structures</td>
<td>structures within 14 days of concrete</td>
<td></td>
</tr>
<tr>
<td></td>
<td>placement</td>
<td></td>
</tr>
<tr>
<td>Backfilling - Tolerance</td>
<td>Check shape of culvert during backfilling</td>
<td>1 working day</td>
</tr>
<tr>
<td>Compaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction adjacent to culverts or</td>
<td>Rectify any damage</td>
<td>2 working days before</td>
</tr>
<tr>
<td>drainage structures</td>
<td></td>
<td>proceeding</td>
</tr>
<tr>
<td>Additional requirements for</td>
<td>Provide if erosion of bedding material</td>
<td>1 week</td>
</tr>
<tr>
<td>compaction of pipe drainage</td>
<td>may occur</td>
<td></td>
</tr>
<tr>
<td>bedding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water sensitive urban design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protection - Buffer strips, swales</td>
<td>Provide temporary protection from</td>
<td>3 working days</td>
</tr>
<tr>
<td>and bioretention systems</td>
<td>construction traffic</td>
<td></td>
</tr>
<tr>
<td>Protection - Permanent protection</td>
<td>Provide permanent protection from vehicular</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>traffic</td>
<td></td>
</tr>
</tbody>
</table>

### 2 PRE-CONSTRUCTION PLANNING

#### 2.1 AUTHORITY APPROVALS

**Traffic control**
Provision for traffic during construction: To 1101 Control of traffic.

**Temporary drainage**
Documentation: Submit details of procedures/devices to maintain effective drainage of the works area during construction. This is a HOLD POINT.

**Road opening permit**
Application: Submit application to the relevant Council for approval to undertake works to road or footpath. This application includes but is not limited to the following information:
- Opening and compaction specifications: To 1152 Road openings and restoration (Utilities).

#### 2.2 ESTABLISHMENT

**Documentation**
Survey control: Required for the following:
- Mapping and pegging the drainage system.
- Locating components.
2.3 SCHEDULING

Program of works
General: Program the works as follows:
- Materials: Arrange the program for compliance and handling of components and materials.
- Authorities: Conform with approvals and the local environmental requirements.
- Constraints: Incorporate HOLD POINTS and WITNESS POINTS.

3 MATERIALS

3.1 GENERAL

Certificate of conformity
 Verification: Provide certificates of conformance to the specification for all pipes, culverts, precast concrete units, access covers, road grates or frames and all materials and components.
 Certificate: Identify the item and record the inspection and test records that verify conformity.

Materials and components
Pipes: To 1352 Pipe drainage.
Precast: To 1353 Precast box culverts.
Structures: To 1354 Drainage structures.

3.2 BEDDING, SUPPORT AND BACKFILL MATERIAL

General
Recycled material: To Specification for supply of recycled material for pavements, earthworks and drainage. Submit for approval any recycled material proposed.

Durability
Geotechnical NATA test: Determine the pH and resistivity of water and soil in conformance with AS 1289.4.3.1 and AS 1289.4.4.1. This is a HOLD POINT.
Test for concentration of impurities: Carry out groundwater or soil extract testing for chloride, sulfate and aggressive CO₂ Testing to conform to AS 1289.4.2.1. This is a HOLD POINT.
Materials and protective treatment for durability: Conform to 1352 Pipe drainage, 1353 Precast box culverts, 1354 Drainage structures.

Bed and haunch zones
Material for bed and haunch zones: Select fill to conform with the following:
- Particle size distribution: Within the limits set out in AS 3725 Table 6 and tested to AS 1141.11.1.
- Plasticity index: To AS 1289.3.2.1 and AS 1289.3.3.1 with a maximum of 6.

Side and overlay zones
Fill material: Select fill material for side and overlay zones of pipes, box culverts and adjacent to other drainage structures to conform with the following:
- Maximum dimension: 50 mm.
- Plasticity index: Between 2 and 12 to AS 1289.3.2.1 and AS 1289.3.3.1.

Material adjacent to weepholes
Requirement: Conform to the following:
- Clean, graded, hard and durable stone or river gravel.
- Nominal particle sizes between 10 and 50 mm.
- Maximum particle dimension < 50 mm.
- Minimum particle dimension < 5% by mass passing the 9.5 mm AS sieve.

Flexible pipes
Embarkment material: If using flexible pipes and the embarkment method, provide embarkment material to AS/NZS 2566.1 clause 3.3 or AS/NZS 2566.2 Appendix G.
4 EXECUTION

4.1 ESTABLISHMENT

Temporary drainage during construction
General: For each part of the drainage system, complete the erosion and sedimentation control measures before commencing the drainage works (except those parts of the drainage system forming part of the control measures).
Control of erosion and sedimentation: Conform to 1102 Control of erosion and sedimentation. Make adequate provision for runoff flows at drainage works under construction or at surrounding areas/structure.
Dams and diversions: Do not dam up or divert existing watercourses (either temporarily or permanently). Submit for approval if required.
Material and equipment: Locate material and equipment clear of watercourses or secure to prevent danger or damage in the event of large runoff flows.
Swales and buffer strips: Protect during construction or make use of the swale as a temporary measure. Provide geotextile with a shallow 50 mm topsoil and instant turf laid perpendicular to the flow path.
Stabilisation of topsoil areas: Immediately following earthworks where required, stabilise the topsoil with hydrosed to 0257 Landscape – roadways and street trees, Hydroseeding.

Siting of culverts
Requirement: Set out the stormwater drainage systems and identify the following:
- The location, lengths and levels at outlets and inlets of pipes and box culvert structures.
- The locations and levels of gully pits, junction boxes, energy dissipators, and inlet and outlet structures.
- The location and levels of the ends of wingwalls and headwalls.
- The location and levels of open drains.
This is a HOLD POINT.
Site conditions: If required to suit site conditions, amend the inlet and outlet locations, designed levels or the culvert length as part of the work covered by the schedule of rates.
Changes by contractor: Submit for approval any proposed change to the culvert location, length, designed levels, culvert strength, conditions of installation or cover to suit construction procedures, and provide proposed culvert set-out in addition to the designed set-out. This is a HOLD POINT.

Excavation near underground services
Public utilities within the excavation for drainage systems: Obtain approval of the relevant authority for the method of excavation before commencing excavation. This is a HOLD POINT.
Contact: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, collecting enquiries and passing them on to affiliated utilities to assist in locating underground pipe and cables (initial response possible within two working days with responses from utilities some time later). See www.1100.com.au. This is a HOLD POINT.
Locations: Obtain locations of water, sewer, stormwater, gas, electricity and telephone services.
Marking: Before commencing earthworks, locate and mark existing underground services in the areas which will be affected by the earthworks operations including clearing, excavating and trenching. This is a HOLD POINT.

Construction traffic
Protection measures: If proposing to move heavy construction plant or vehicles over pipe or box culverts structures, provide verification and certification of protective measures. This is a HOLD POINT.

Existing structures
Existing redundant drainage structures: Demolish and remove existing redundant pipe culverts, head walls and pits as shown on the drawings.
4.2 OPEN DRAINS

General
Detail: Provide open drains, associated embankments and protective linings in conformance with 1121 Open drains, including kerb and gutter.

4.3 EXCAVATION FOR DRAINAGE SYSTEMS

General
Topsoil: Remove topsoil in conformance with 1112 Earthworks (Roadways) before undertaking stormwater drainage excavation.
Trench support stabilising: Provide any shoring, sheet piling or other stabilisation of the sides of trench excavations necessary to conform to statutory requirements.
Excavation level: Excavate trench or foundation for stormwater drainage works to the designed level of the bottom of the bedding or foundation. Remove all loose material.
Excavation: Level beds of swales, batter slopes and bioretention trenches shown on the drawings.
Confirmation: Confirm surrounding soil type with design. Give notice if not consistent with the design. This is a HOLD POINT.

Pipelines
Trench size for pipelines: Excavate the trench to AS/NZS 3725. This is a WITNESS POINT.
Installation condition: As required by the Conditions of Development Consent and the detail of the Construction Certificate.
Side zones of pipe trenches: Density and stiffness requirements to AS/NZS 3725 clause 9.2.3.1 for Type HS3 support.
Embarkment installation condition: Prior to placement of bedding and laying pipes, place and compact embankment fill to a height above the top of the bed zone of at least 0.7 times the external diameter of the pipe and for a minimum lateral distance outside each trench wall of 2.5 times the external diameter of the pipe. Place earthworks to 1112 Earthworks (Roadways).
Trench installation condition: Complete the embankment to the underside of the selected material zone prior to the commencement of the excavation.

Drainage structures other than pipes
Excavation: Provide clear width between the structure wall and the face of the excavation as the greater of the following:
- 300 mm.
- 1/3 of the excavation face height. This is a WITNESS POINT.

Inadequate foundation material
Notice: Give notice of any area of the foundation including the sides of the trenches that may contain material that is inadequate to support the proposed drainage structure. This is a WITNESS POINT.
Confirmation of inadequate foundation material: Remove and dispose of inadequate foundation material to 1112 Earthworks (Roadways) and replace the material to Bedding, support and backfill material.
Rock foundation: If rock is encountered at the foundation level, excavate for an additional depth. Backfill and compact the additional excavation with material conforming to the requirements for HS3 pipe support. This is a WITNESS POINT.

4.4 BEDDING AND BACKFILLING

Pipe Bedding
Type: Provide bedding depths and compaction for concrete pipes to Pipe installation dimensions table.

<table>
<thead>
<tr>
<th>Pipe support type</th>
<th>U</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
<th>HS1</th>
<th>HS2</th>
<th>HS3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension (minimum)</td>
<td>x</td>
<td>75 on rock and NIL on soil</td>
<td>100 for D ≤ 1500</td>
<td>0.25 D but &gt; 100</td>
<td>100 for D ≤ 1500</td>
<td>1500 for D &gt; 1500</td>
<td></td>
</tr>
<tr>
<td>y</td>
<td>0.1D</td>
<td>0.3D</td>
<td>0.3D</td>
<td>0.1D</td>
<td>0.3D</td>
<td>0.3D</td>
<td>≥ 0.7D</td>
</tr>
<tr>
<td>z</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© AUS-SPEC (Oct 12) 7 April 2016
Flexible pipework minimum cover and embedment geometry: To AS/NZS 2566.1 Table 3.1 and Figure 3.1.

**Uncompacted bedding for steel pipes and pipe arches**
Tolerance: Provide minimum 75 mm thick uncompacted bedding material between the foundation and the outer surface of corrugations.
Firm support: Submit details for achieving a dense bedding zone for uniform firm support of the corrugated structure by ramming or other methods. This is a HOLD POINT.

**Backfilling**
In situ concrete structures: Do not backfill against in situ concrete drainage structures within 14 days of concrete placement. This is a WITNESS POINT.
Trench backfill material: Backfill the remainder of the trench to the underside of the subgrade, or selected material zone in conformance with 1112 Earthworks (Roadways).
Sequence: Commence backfilling and compaction at the pipe or wall to confine future backfill material.
Dimension: Place backfill around the steel pipe or structure, equally balanced on both sides, to the minimum dimension shown on the drawings or as directed.
Tolerance: Check the shape of the culvert during backfilling to ensure that on completion of backfilling, the vertical and horizontal centreline dimensions of the pipe or structure do not vary from the manufacturer’s specified dimensions by more than ± 2% for pipes and pipe arches. This is a WITNESS POINT.

**4.5 COMPACTION**

**Foundations, bedding and backfilling**
Foundations, bedding (other than for pipe drainage) and backfilling: To the Compaction table, tested in conformance with AS 1289.5.4.1 for standard compactive effort.

**Compaction table**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Relative compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations or trench base:</td>
<td></td>
</tr>
<tr>
<td>-to a depth of 150 mm below foundation levels</td>
<td>95%</td>
</tr>
<tr>
<td>-material replacing unsuitable material</td>
<td>95%</td>
</tr>
<tr>
<td>Bedding material</td>
<td>95%</td>
</tr>
<tr>
<td>Selected backfill and ordinary backfill material:</td>
<td></td>
</tr>
<tr>
<td>-below 1.5 m of finished surface</td>
<td>95%</td>
</tr>
<tr>
<td>-within 1.5 m of finished surface</td>
<td>100%</td>
</tr>
<tr>
<td>Backfill material within the selected material zone</td>
<td>100%</td>
</tr>
</tbody>
</table>

Compaction layers thickness: Compact all material in layers not exceeding 150 mm compacted thickness and to the required relative compaction before the next layer is commenced.

Moisture content range: At the time of compaction, adjust the moisture content of the material to permit attainment of the required compaction (within the range 60% to 95% of the optimum moisture content), as determined by AS 1289.5.7.1 (standard compaction).

**Compacting adjacent to culverts or drainage structures**
Method: If compacting adjacent to culverts or drainage structures, adopt compaction methods which do not cause damage or misalignment.
Damage: Give notice and rectify any damage caused. This is a WITNESS POINT.

**Additional requirements for compaction of pipe drainage bedding**
Protection of the pipe from construction damage: If required, adjust the layer thickness to avoid damaging the pipe e.g. for the first placed layer above the pipe crown in the overlay zone.
Bed and haunch zones compaction: Select fill material compaction to the appropriate pipe support requirements for concrete pipes in Bedding material compaction requirements table.

<table>
<thead>
<tr>
<th>Bedding material compaction requirements table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bedding material</strong></td>
</tr>
<tr>
<td><strong>Criteria</strong></td>
</tr>
<tr>
<td>Minimum Relative</td>
</tr>
<tr>
<td>Compaction %</td>
</tr>
<tr>
<td>(Compaction)</td>
</tr>
<tr>
<td>Cohesive</td>
</tr>
</tbody>
</table>

Material directly under the pipe support: Place and shape the top 0.1D mm of the bedding and haunch material directly under the pipe.

H3 pipe support including concrete bedding: Provide concrete grade N20 to AS 3600. Make sure pipe is suitably reinforced in conformance with AS 3725 as standard elliptically reinforced pipe may not be adequate for H3 pipe support.

Cementitious stabilisation in the bedding and haunch zones: Provide cementitious stabilisation, if the impermeability of the natural ground and the slope of the drainage line is such that erosion of bedding material may occur. This is a WITNESS POINT.

### 4.6 CONCRETE WORK

**General**

Requirement: Supply and place normal class concrete, sprayed concrete, steel reinforcement, formwork and provide tolerances, construction joints, curing and protection to 0319 Minor concrete works and as shown on the drawings.

### 4.7 WATER SENSITIVE URBAN DESIGN

**Protection**

WSUD features that incorporate special soils and vegetation shall not be constructed and incorporated into the stormwater drainage system until after the site has been completed so construction waste materials do not damage the WSUD aspects.

Buffer strips, swales and bioretention systems: Do not allow any construction traffic access to areas of WSUD or infiltration tools to ensure that the soil compaction remains unaffected and as designed. Provide fences where required to 1195 Boundary fences for road reserves. This is a WITNESS POINT.

Permanent protection: Install bollards, signposting or other street furniture to protect the constructed vegetated areas from damage such as parking of cars. Conform to 1192 Signposting and 1193 Guide posts. This is a WITNESS POINT.

**Vegetated swales and buffer strips**

Details: Conform to the drawings and to the following requirements where appropriate.

- Preventing ponding: Provide a perforated pipe beneath the swale drain.
- Geometry: Trapezoidal or parabolic shapes, side slopes no steeper than 3H:1V.
- Longitudinal slope: Conform to the following if longitudinal slope is not within 1 to 4%:
  - Install check dams for slopes greater than 4%.
  - Install under drains for slopes less than 1%.
- Maximum swale width: 2.5 m.

**Bioretention systems**

- Depth of filter media: Between 0.3 mm and 0.7 mm, as shown on drawings.
- Saturated hydraulic conductivity: Between 200 mm/hr and 500 mm/hr.
- Perforated pipe capacity: Ensure perforated pipe capacity is greater than the infiltration capacity of the filter media.
- Depth of drainage layer: 150 mm to 200 mm.
- Drainage layer material: Coarse sand (1 mm) or fine gravel (2 to 5 mm).
Impermeable liner: If the surrounding soil is free draining use an impermeable liner on the base and sides.

Liner type: As specified in the CC drawings.

Transition layer: Minimum 100 mm thick layer of sand or geotextile fabric.

Gross Pollution Treatment (GPTs) as part of a treatment system

General: Provide GPTs as shown on the drawings.

Treatment objectives: To capture gross pollutants litter and vegetation larger than 5 mm and sediment particles larger than 0.125 mm.

Landscape and vegetation

Landscape and vegetation: Conform to this worksection and 0257 Landscape – Roadways and street trees.

Minimum depths of topsoil: Conform to the following:
- 150 mm for turf species.
- 300 mm for ground covers and small shrubs.
- 450 mm for large shrubs.
- 600 mm for trees.

Plant species selection: If required, conform to the species as shown on the drawings and submit plant selection for a particular area for approval. Give attention to the plant selection requirements for constructed wetlands, sedimentation basins, ponds and lakes. This is a HOLD POINT.

Stormwater re-use

Requirement: Provide stormwater re-use collection, storage, treatment and distribution in conformance with the drawings and this worksection.

Application rate for irrigation: As required by the Conditions of Development Consent.

4.8 COMPLETION

Inspection

Closed circuit television (CCTV) inspections: Submit a report including video evidence for all drainage structures as follows:
- On completion of all drainage structures and prior to commencement of pavement construction above the drainage structure to verify the works are within the specified tolerances and without visual signs of structural failure.
- No more than 14 days prior to completion to verify tolerances and ensure that there is no obstruction to the flow of water.

Testing

Quality: Test and submit reports for all characteristics in conformance with 0161 Quality (Construction).

Flushing

General: On completion of the entire system, flush all pipes clean from end to end and leave in proper working order.

5 LIMITS AND TOLERANCES

Application

Summary: The limits and tolerances applicable to this worksection are summarised in Summary of limits and tolerances table.

Summary of Limits and Tolerances

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection clause reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fill for bed and haunch zones</td>
<td></td>
<td>Bedding, support and backfill material</td>
</tr>
<tr>
<td>- Maximum size of particles</td>
<td>50 mm</td>
<td></td>
</tr>
<tr>
<td>- Plasticity index</td>
<td>2-12</td>
<td></td>
</tr>
<tr>
<td>Fill adjacent to weepholes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Particle size</td>
<td>10 – 50 mm</td>
<td></td>
</tr>
</tbody>
</table>
### Activity

#### Excavation for drainage structures other than pipes

- **Clear width between wall of structure and face of excavation**
  - The greater of 300 mm and 1/3 the face of excavation height

- **Uncompacted bedding and backfill**
  - Minimum 75 mm thick

- **Maximum permitted distortion of pipes and pipe arches**
  - ± 2% from manufacturers specified dimensions

- **Minimum thickness of compacted layer**
  - 150 mm

- **Maximum width of vegetated swales and buffer strips**
  - 2.5 m

- **Bioretention systems**
  - **Depth of filter media**
    - 0.3 – 0.7 mm
  - **Saturated conductivity**
    - 200 – 500 mm/hr
  - **Depth of drainage layer**
    - 100 – 200 mm
  - **Transition layer of sand or geotextile fabric**
    - 100 mm

- **Landscape and vegetation**
  - **Minimum topsoil depths**
    - -150 mm for turf species
    - -300 mm for ground covers and small shrubs
    - -450 mm for large shrubs
    - -600 mm for trees

---

### 6 MEASUREMENT AND PAYMENT

**Note:** This item is an Optional condition for Development. Required for Council Project.

#### 6.1 MEASUREMENT

**General**

Payments made to the Schedule of Rates: To 0152 Schedule of rates -- supply projects, this worksection, the drawings and Pay items 1351.1, 1351.2 and 1351.3.

Lump Sum prices: Not acceptable.

Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

**Methodology**

The following methodology will be applied for measurement and payment:

- Erosion and sedimentation control: To 1102 Control of erosion and sedimentation.
- Topsoil removal: To 1112 Earthworks (Roadways).
- Concrete work: To 1352 Pipe drainage, 1353 Precast box culverts or 1354 Drainage structures.
- Sprayed concrete work: To 0319 Minor concrete works.
- Rock filled wire mattresses and gabions: To 1121 Open drains, including kerb and gutter.
- Excavation and stone pitching of open drains: To 1121 Open drains, including kerb and gutter.
- Miscellaneous minor concrete work: To 0319 Minor concrete works.
### 6.2 PAY ITEMS

Note: This item is an Optional condition for Development. Required for Council Project.

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1351.1 Excavation and backfilling for stormwater drainage culverts and</strong></td>
<td>m³ measured as volume excavated:</td>
<td>The Schedule rate for this Pay Item to be an average rate to cover all types of material excavated including both earth and rock. All costs associated with all activities for the excavation of material and backfilling as specified including setting out and associated survey, replacement of unsuitable material, replacement of over-excavation, control of stormwater runoff, temporary drainage, erosion and sediment control, disposed of excess or unsuitable material.</td>
</tr>
<tr>
<td><strong>structures.</strong></td>
<td><strong>Box culverts:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Plan area calculated from base slab dimensions plus 300 mm and wingwalls as shown on the drawings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Depth is average actual site measurement from the bottom of the specified bedding to the ground surface after stripping topsoil.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Other drainage structures:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Plan area from outside dimensions as shown on the Drawings.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Depth is average actual site measurement from the bottom of the specified bedding to the ground surface after stripping topsoil.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Unsuitable material under culverts and drainage structures:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Actual plan area and average depth below bedding of material removed.</td>
<td></td>
</tr>
<tr>
<td><strong>1351.2 Excavation for pipe drainage, pipes, structures.</strong></td>
<td>m³ measured as volume of excavated material calculated for each component to Annexure A.</td>
<td></td>
</tr>
<tr>
<td><strong>1351.3 Inadequate foundation material under drainage structures and open drains.</strong></td>
<td>m³ measured as of excavated material.</td>
<td>The Schedule rate for this Pay Item to be an average rate to cover all types of material excavated including both earth and rock. All costs associated with all activities for the excavation, removal, replacement and disposal of inadequate foundation material traffic control, erosion control.</td>
</tr>
</tbody>
</table>
ANNEXURE

Note: This item is an Optional condition for Development. Required for Council Project.

Annexure A
Schedule of excavation dimension for PAY ITEM 1351.2.

Excavation for reinforced concrete and fibre reinforced cement pipes

<table>
<thead>
<tr>
<th>Positive projection (if excavation required)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Depth</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td><strong>Length</strong></td>
</tr>
</tbody>
</table>

**Wide trench**

| **Width** | **Single cell:** | **External pipe diameter +1 m.** |
|          | **Multi cell:** | Sum of external diameters + sum of spacings between pipes measured square to the line of the culvert + 1 m. |
| **Depth** | **In natural ground** | Average actual depth form topsoil stripped ground surface to underside of specified bedding. |
|          | **In embankment** | Maximum 500 mm above top of pipe to underside of specified bedding. |
| **Length** | | Actual excavation length, centre to centre of pits or centre of pit to face of headwall. |

**Normal trench**

| **Width** | 1.4 x external pipe diameter or + 300 mm on each side, whichever is the greater. |
| **Depth** | **In natural ground** | Average actual depth form topsoil stripped ground surface to underside of specified bedding. |
|          | **In embankment** | Maximum 500 mm above top of pipe to underside of specified bedding. |
| **Length** | | Actual excavation length, centre to centre of pits or centre of pit to face of headwall. |
Steel pipes and pipe arches

<table>
<thead>
<tr>
<th>Width</th>
<th>Wide trench</th>
<th>External pipe diameter or span + 2 x external pipe diameter or span.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normal trench</td>
<td>External pipe diameter or span + 600 mm on each side.</td>
</tr>
<tr>
<td>Depth</td>
<td>As for RC and FRC pipes.</td>
<td></td>
</tr>
</tbody>
</table>

Flexible pipes

<table>
<thead>
<tr>
<th>Width</th>
<th>for pipes of:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ext dia at collar</td>
<td>External diameter of pipe + 200 mm ≥75 ≤150.</td>
<td></td>
</tr>
<tr>
<td>Ext dia at collar</td>
<td>External diameter of pipe + 300 mm ≥150 ≤300.</td>
<td></td>
</tr>
<tr>
<td>Ext dia at collar</td>
<td>External diameter of pipe + 400 mm ≥300 ≤450.</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>Average actual depth excavated.</td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>Actual excavation length, centre to centre of pits or centre of pit to face of headwall.</td>
<td></td>
</tr>
</tbody>
</table>
1352 PIPE DRAINAGE

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide the pipework for the drainage system as documented.

Performance
Requirements: As required by the Conditions of Development Consent.
Selections: As documented.

Design
- design details and all the design parameters for the project design. Designer: RP Eng/CP Eng to RP Eng/CP Eng standard to authorise design by signature.

Design life of pipe drainage system: 100 Years.

Authority requirements: As required by the Conditions of Development Consent including Fisheries approvals.

REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1112 Earthworks (Roadways).
- 1171 Subsurface drainage.
- 1351 Stormwater drainage (Construction).
- 1354 Drainage structures.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used

AS/NZS 1260 PVC-U pipes and fittings for drain, waste and vent application
AS/NZS 1477 PVC pipes and fittings for pressure applications
AS 1646 Elastomeric seals for waterworks purposes
AS/NZS 2041 Buried corrugated metal structures
AS/NZS 2041.1 Design methods
AS/NZS 2041.4 Helically formed sinusoidal pipes
AS/NZS 2041.6 Bolted plate structures
AS/NZS 2566 Buried flexible pipelines
AS/NZS 2566.1 Structural design
AS/NZS 2566.2 Installation
AS 2758 Aggregates and rock for engineering purposes
AS 2758.1 Concrete aggregates
AS/NZS 4058 Precast concrete pipes (pressure and non-pressure)
AS/NZS 4130 Polyethylene (PE)pipes for pressure applications
AS 4139 Fibre reinforced concrete pipes and fittings
AS/NZS 5065 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
AS/NZS ISO 9001 Quality management systems – Requirements
AASHTO M190 Standard specification for bituminous coated corrugated metal culvert pipe and pipe arches
AASHTO M196 Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M197 Standard Specification for Aluminum Alloy Sheet for Corrugated Aluminum Pipe
Other publications
Concrete Pipe Association of Australasia
CPAA Concrete pipe website and pipeclass software
Plastics Industry Pipe Association of Australia PIPA
POPO01-2011 Electrofusion jointing of PE pipe and fittings for pressure applications
POPO03-2011 Butt fusion jointing of PE pipes and fittings – recommended parameters
POPO12-2009 Solvent cement jointing of PVC pipe

1.4 INTERPRETATIONS

Abbreviations
General: For the purposes of this worksection the abbreviations given below apply.
- SRCP: Steel reinforced concrete pipes.

Definitions
General: For the purposes of this worksection the definitions given below apply.
- Effective pipe length: The centre-line length dimension specified by the manufacturer and subject to permissible tolerances.
- RMS- Roads and Maritime Services.

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent’s / Council’s Engineering Development Officer approval.

Documents
Submit the following for approval:
- Materials: Batch certification to AS/NZS ISO 9001 and AS/NZS 4058 or AS 4139 as appropriate.
- Manufacturers data and installation recommendations.
- Work-as-executed drawings: As required by the Conditions of Development Consent.
- Components: Pipes and fittings.
- Execution details: Refer to HOLD POINTS.

1.6 HOLD POINTS AND WITNESS POINTS

Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

**HOLD POINTS table**

<table>
<thead>
<tr>
<th>Clause title/item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certification</td>
<td>Submit manufacturers certification</td>
<td>2 weeks prior to dispatch</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Corrugated aluminium pipes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Durability</td>
<td>Submit for approval the protective treatment to achieve the expected design life</td>
<td>1 week before application</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Plastic Flexible pipes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Proprietary product</td>
<td>Submit for approval prior to construction</td>
<td>2 weeks</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Progressive inspections</td>
<td>Give notice for completed installation and jointed pipes for inspection</td>
<td>Progressive before backfilling</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
</tbody>
</table>
WITNESS POINTS table

<table>
<thead>
<tr>
<th>Clause title/item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drainage - Handling and storage damage</td>
<td>Repair or replace damaged</td>
<td>1 week</td>
</tr>
<tr>
<td></td>
<td>units</td>
<td></td>
</tr>
<tr>
<td>Installation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joints for concrete pipes</td>
<td>Submit joint test results</td>
<td>Progressive</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 SCHEDULING

Program of works
General: Program the works as follows:
- Materials: Arrange the program for compliance and usage of components and materials.
- Authorities: Arrange approvals and confirm environmental requirements.
- Ground conditions: Identify and report on adverse ground conditions affecting selection of pipe materials.

3 MATERIALS

3.1 GENERAL

Certification
Quality: Prior to dispatch of each batch to site, submit manufacturer's certification to the relevant pipe standard code. This is a HOLD POINT.

Ground conditions
Ground condition: If the chemical composition for the soil is unknown or not tested use the default condition 'Aggressive' to AS/NZS 2041.1, AS/NZS 4058 or AS 4139.

3.2 CONCRETE PIPES

Precast reinforced concrete pipes
Requirement: Provide precast reinforced non-pressure concrete pipes to AS/NZS 4058 and in conformance with the following:
- Pipe class and size as shown on the drawings.
- Tolerance: ±15 mm from manufacturer's nominated effective pipe length.
- Jointing type: Provide flexible rubber ring, spigot and socket joints to AS 1646 (use flush or butt joints only for the first pipe when extending existing pipes).
- Load classes: As shown on the drawings.
- Clear cover to reinforcement: Based on normal environments to AS/NZS 4058 Table 3.3.
- Maximum limit of water absorption: 6.0%.
- Tests required: Routine tests for cover and dimensional accuracy.
Marking: To AS/NZS 4058.
Durability: Protective treatments to AS/NZS 4058 Appendix E and the manufacturer's recommendations.
Protective treatment: Where pipes are to be laid in nominated acid sulphate soils, high salinity or other aggressive environments the pipes are to be fully protected to be fully durable as above. THIS IS A WITNESS POINT. As required by the Conditions of Development Consent.
4.1 PROVISION FOR TRAFFIC

General
Control of traffic: Conform to the following:
- Worksection 1101 Control of traffic: Traffic Guidance Scheme.

4.2 ESTABLISHMENT

General
Excavation drainage: Dewater the excavation to permit the compaction of the foundation, the bedding and any backfilling as documented.
Tolerances dimensions: Provide culverts within 10 mm of the grade line and within 10 mm of the horizontal alignment as shown on the drawings.
Re-install: Relay any culvert which is not within tolerance.
Subsurface drain location: At the discharge end of culverts terminating at pits and headwalls, provide a 3 m length of 100 mm diameter subsurface drain.
- Position: In the trench 100 mm above the invert level of the Pipe.
- Discharge: Through the wall of the pit or headwall.
Detail: Seal the subsurface drainage pipe at the upstream end and enclose in a seamless tubular filter fabric in conformance with 1171 Subsurface drainage.

Construction plant movement
Loads: If the movement of construction plant in excess of 5 t gross mass over pipes is proposed, submit details including design protective measures for the crossings.

Damage
Handling and storage: Repair damaged units in conformance with manufacture's requirements.
Replace units if unable to repair satisfactorily. This is a WITNESS POINT.
Inspection of pipeline components: Inspect all pipe line components for damage and flaws immediately before installation.

4.3 INSTALLATION

General
Stiffening of culverts: If required by the manufacturer, provide temporary stiffening struts to the interior prior to filling.
Lifting holes: Prior to backfilling seal lifting holes in all pipes with approved plastic preformed plugs or a 3:1 sand cement mortar.
Bulkhead locations: Construct bulkheads in conformance with 1354 Drainage structures on all lines where the pipe gradient exceeds 5%.
Bulkheads for flexible pipes: If required, provide bulkheads or trench stops if required to AS/NZS 2566.2 Table 5.7 or as shown on the drawings.
Progressive inspections: For each section of the work, give notice for inspection of the completed installation and jointed pipes before commencement of trench backfilling. This is a HOLD POINT.
Plastic culvert 'float' precautions: To ensure plastic pipe culverts do not 'float' during the backfilling and vibration process, take appropriate precautions such as holding down straps.

Positioning of pipes
Lay pipes: Install pipes with the socket end upstream.
Top designation: Install pipes which have marks indicating the crown or invert strictly in conformance with the markings.
Length: Provide pipe with minimum length of 1.2 m.
Laying and jointing for flexible pipes: Install pipes to AS/NZS 2566.2 Section 5 and to the manufacturer's recommendations.

Anchor blocks: Provide anchor blocks at a maximum spacing of 3 m and at bends or junctions for all stormwater pipes laid on a grade exceeding 20% and as shown on the drawings. Place in situ concrete directly against all faces of the keys in the sides and base of the trench.

**Joints for concrete pipes**

Rubber ring joints in reinforced concrete pipes: Complete rubber ring joints to the manufacturer's recommendations.

Joint testing: Submit joint test results. This is a **WITNESS POINT**.

Fibre reinforced concrete pipes: Test joints to AS 4139 Appendix L.

Precast concrete pipes: Test joints to AS/NZS 4058 Appendix H.

Skid rings: To the manufacturer's recommendations, including the use of lubricants if wedge shaped 'skid' rubber rings are required.

Jointing: Provide flush or butt joints only if required to extend existing culverts.

Sealing: Seal the joints with proprietary rubber sleeves in conformance with the manufacturer's recommendations.

Joints in fibre-reinforced cement pipes: Provide flexible type joints using rubber rings to seal joints in both rebated and spigot and socket jointed pipes or use a jointing compound comprising plasticised butyl rubber and inert fillers all in conformance with the manufacturer's recommendations.

Other joints: Make direct side connections to other pipes as shown on the drawings.

### 4.4 LIMITS AND TOLERANCES

**Application**

Summary: The limits and tolerances applicable to this worksection are summarised in **Summary of limits and tolerances table**.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection clause Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variation from nominated effective pipe length</td>
<td>± 15 mm</td>
<td>Concrete pipes</td>
</tr>
<tr>
<td>Maximum limit of water absorption</td>
<td>6.0%</td>
<td></td>
</tr>
<tr>
<td>Fibre reinforced concrete pipes:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test frequency:</td>
<td>One pipe per 50 pipes.</td>
<td></td>
</tr>
<tr>
<td>Culverts:</td>
<td></td>
<td>Establishment</td>
</tr>
<tr>
<td>- Grade line</td>
<td>± 10 mm</td>
<td></td>
</tr>
<tr>
<td>- Horizontal alignment</td>
<td>± 10 mm</td>
<td></td>
</tr>
<tr>
<td>Subsurface drain:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Length</td>
<td>3 m</td>
<td></td>
</tr>
<tr>
<td>- Diameter</td>
<td>100 mm</td>
<td></td>
</tr>
<tr>
<td>- Location</td>
<td>100 mm above the invert level</td>
<td></td>
</tr>
<tr>
<td>Lifting plugs seal</td>
<td>3:1 sand cement mortar</td>
<td>Installation</td>
</tr>
<tr>
<td>Bulkhead locations</td>
<td>&gt; 5% gradient in pipeline</td>
<td></td>
</tr>
<tr>
<td>Minimum length</td>
<td>1.2 m</td>
<td>Positioning of pipes</td>
</tr>
<tr>
<td>Anchor blocks:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Maximum spacing</td>
<td>3 m</td>
<td></td>
</tr>
<tr>
<td>- Location</td>
<td>&gt; 20% gradient in pipeline</td>
<td></td>
</tr>
<tr>
<td>Annular corrugations</td>
<td>65 mm pitch</td>
<td>Joints for steel pipes</td>
</tr>
<tr>
<td>Geotextile cover material:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Limits/Tolerances</td>
<td>Worksection clause Reference</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>-------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>- Width</td>
<td>250 mm</td>
<td></td>
</tr>
<tr>
<td>- Minimum mass</td>
<td>270 grams/m²</td>
<td></td>
</tr>
<tr>
<td>Invert protection sprayed concrete</td>
<td></td>
<td>Invert protection for steel pipes</td>
</tr>
<tr>
<td>- Over crest of corrugations over bottom third of pipe circumference</td>
<td>&gt; 100 mm</td>
<td></td>
</tr>
<tr>
<td>Sprayed concrete reinforcement:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Reinforcement</td>
<td>Steel wire 4 mm diameter with 200 mm square mesh</td>
<td></td>
</tr>
<tr>
<td>- Laps in fabric</td>
<td>300 mm</td>
<td></td>
</tr>
<tr>
<td>- Cover</td>
<td>50 mm</td>
<td></td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

5.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, as shown on the Drawings and Pay Item 1352.1.
Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
Excavation, bedding, support and backfill material: Conform to 1351 Stormwater drainage (Construction).
- Miscellaneous minor concrete work not included in the pay items in this worksection: Conform to 0319 Minor concrete works.
- Bulkheads: Conform with 1354 Drainage structures.

5.2 PAY ITEM

<table>
<thead>
<tr>
<th>Pay Items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1352.1 Supply and install pipe drainage culverts, pipes, structures.</td>
<td>Linear m of pipe drainage culvert:</td>
<td>The Schedule rate for this Pay Item to be a rate for each type, class and size of pipe culvert. All costs associated with all activities for supply, survey and setting out including:</td>
</tr>
<tr>
<td></td>
<td>- Measured on centreline of each type, class and size of stormwater drainage pipe culvert.</td>
<td>- Supply.</td>
</tr>
<tr>
<td></td>
<td>- The plan length between centres of gully pits or faces of headwalls.</td>
<td>- Survey and setting out.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Bedding.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Jointing (including connections).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Subsoil drains at pits and headwalls.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Temporary bracing and strutting.</td>
</tr>
<tr>
<td>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Anchoring system including anchor blocks.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Bituminous painting.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sprayed concrete lining and other protective measures.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Selected material backfilling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Embankment material trench backfilling.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Reinforcing fabric.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Disposal of excesses of unsuitable material.</td>
</tr>
</tbody>
</table>
1353 PRECAST BOX CULVERTS

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide precast box culvert units including construction of base slabs as documented.

Performance
Requirements: As required by the Conditions of Development Consent.

Design
- design details and all the design parameters for the project
designer: RPEng/CPEng to RP Eng/CPEng

Design life of culvert: 100 Years.
Authority requirements: As required by the Conditions of Development Consent including Fisheries approvals.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- 0136 General requirements (Construction)
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1121 Open drains, including kerb and gutter.
- 1141 Flexible pavement base and subbase.
- 1171 Subsurface drainage.
- 1172 Subsoil and foundation drains.
- 1351 Stormwater drainage (Construction).
- 1352 Pipe drainage.
- 1354 Drainage structures.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Note: Only the most current standards are to be used

- AS 1012 Methods of testing concrete
- AS 1012.9 Determination of the compressive strength of concrete specimens
- AS 1379 Specification and supply of concrete
- AS 1478 Chemical admixtures for concrete, mortar and grout
- AS 1478.1 Admixtures for concrete
- AS/NZS 1554 Structural steel welding
- AS/NZS 1554.3 Welding of reinforcing steel
- AS 1597 Precast reinforced concrete box culverts
- AS 1597.1 Small culverts (not exceeding 1200 mm span and 1200 mm height)
- AS 1597.2 Large culverts (from 1500 mm span and up to and including 4200 mm span and 4200 mm height)
- AS 2758 Aggregates and rock for engineering purposes
- AS 2758.1 Concrete aggregates
- AS 3600 Concrete structures
- AS 3610 Formwork for concrete
- AS 3972 General purpose and blended cements
- AS/NZS 4671 Steel reinforcing materials
AS/NZS ISO 9001  
Quality management systems – Requirements  

Other publications  
Note: Only the most current standards are to be used  

AUSTROADS  

AGPT04G/09  
Guide to Pavement Technology Part4G – Geotextiles and Geogrids  
National Precast Concrete Association Australia  
NP:PCH  
Precast Concrete Handbook  

1.4 STANDARDS  

General  
Small culverts: To AS 1597.1.  
Large culverts: To AS 1597.2.  
Precast culverts: To the recommendations in NP:PCH Precast concrete handbook.  

1.5 INTERPRETATION  

Definitions  
General: For the purposes of this worksection the definitions given in AS 1597.1, AS 1597.2, as appropriate and below apply:  
- Large culvert unit: Culvert unit with a span from 1500 mm up to 4200 mm and a height up to 4200 mm.  
- Precast box culvert: Includes link slabs and precast reinforced concrete crown sections.  
- Small culvert unit: Culvert unit with a span up to 1200 mm and a height up to 1200 mm.  
- RMS- Roads and Maritime Services.  

1.6 SUBMISSIONS  

Approval  
Submissions: To the Superintendent’s approval.  

1.7 HOLD POINTS AND WITNESS POINTS  

Notice  
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.  

| HOLD POINTS table | |
|-------------------|-----------------|------------------|----------------|
| Clause | Item | Requirement | Notice for inspection | Release by |
| **MATERIALS** | | | | |
| Precast concrete | | | | |
| General - Certificate | Submit certificate of conformance | 3 working days prior to dispatch | Superintendent |
| Testing - Prototype load testing | Submit certificate and test results | 3 working days prior to dispatch | Superintendent |
| **EXECUTION** | | | | |
| Coffer dams | | | | |
| Construction of coffer dams | Submit construction details for approval. | 1 week prior to construction | Superintendent |
| Handling, delivery and storage | | | | |
| General - Inspection | Inspect box culvert units for conformance | 1 week prior to installation | Superintendent & the Councils Engineering Development Officer |
| Establishment | | | | |
| Pegging of culverts | Present set out of centrel ine and inverts | 3 working days | Superintendent |

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2  
April 2015
<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedding</td>
<td>Select from bedding alternatives</td>
<td>1 week before placing material</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Placement of units - Inspection of seals</td>
<td>Present joints and seals for before backfilling</td>
<td>1 working day</td>
<td>Superintendent &amp; the Council's Engineering Development Officer</td>
</tr>
<tr>
<td><strong>Completion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction loading on culvert - Constraint</td>
<td>Do not load base slab until strength has reached 32 MPa</td>
<td>28 days</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Construction loading on culvert - Construction vehicles or plant</td>
<td>Submit procedure for prevention of early loading</td>
<td>1 week prior to loading</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table**

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precast concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling and testing</td>
<td>Provide test results</td>
<td>3 working days</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffer dams</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber or bracing removal</td>
<td>Inspect removal of bracing materials</td>
<td>1 working day</td>
</tr>
<tr>
<td>Establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diversion and disposal of water</td>
<td>Submit water management plan for approval</td>
<td>1 week</td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cast in situ base slabs</td>
<td>Attainment of concrete minimum compressive strength</td>
<td>1 working day</td>
</tr>
<tr>
<td><strong>Backfill</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Wingwalls</td>
<td>Wait 21 days after concrete placement to commence backfill</td>
<td>21 days</td>
</tr>
<tr>
<td>General – Balancing backfill</td>
<td>Control balanced backfill procedure</td>
<td>1 working day</td>
</tr>
</tbody>
</table>

## 2 PRE-CONSTRUCTION PLANNING

### 2.1 SCHEDULING

**Program of works**

General: Program the works as follows:
- Materials: Arrange the program for compliance and usage of component and materials.
- Authorities: Arrange approvals and confirm with the local environmental requirements.
- Constraints: Incorporate constraints of HOLD POINTS and WITNESS POINTS.
3 MATERIALS

3.1 CONSTITUENT MATERIALS

Cement
Standard: To AS 3972.
Type: Do not use high alumina cement.

Aggregates
Standard: To AS 2758.1.

Water
Standard: To AS 1379.
Quality: Provide clean water, free from oil, acid, alkali, organic or vegetable matter and having not more than 300mg/L of chloride ions.

Other
Chemical admixtures: To AS 1478.1.
Durability: Do not use admixtures containing nitrates, calcium chloride, significant chlorides or other strongly ionized salts.

Reinforcement
Standard: To AS/NZS 4671.
General: Clean and free from harmful matter. e.g. loose mill scale, loose rust, oil, grease and retarders. Ensure there is no pitting.
Corrosion protection: To AS 3600 clause 17.2.
Structural welding: To AS/NZS 1554.3.
Reinforcement: Provide starter bars in the factory for end units for headwall and wingwall construction.

Cast-in items
Cast in inserts: Provide structural steel cast in lifting items as shown on the drawings.
Protective coating: Apply NP:PCH Precast concrete handbook clause 3.3. Select from primer paint, zinc-rich paint and hot-dip galvanising. Requires stainless steel in saline rich areas.

3.2 FORMWORK

Formed concrete surface
Requirement: Conform to the following:
- Smooth, dense and dust free concrete finish.
- Unobtrusive form joint marks.
- No blowholes deeper than 5 mm.
- Class 3 formwork to AS 3610.
- Surface irregularities: Maximum 3 mm over the width of the surface.

Unformed concrete surface
Requirement: Conform to the following:
- Wood float to a uniform surface without pitting or cavities.
- Surface irregularities: Maximum 5 mm over the width of the surface.

3.3 PRECAST CONCRETE

General
Concrete: To AS 1379.
Casting: Do not remove precast units from casting mould until the concrete compressive strength > 15 MPa.
Concrete production, placement and curing: Conform to AS 1597.1 clause 2.6 or AS 1597.2 clause 2.6 and 2.7 as appropriate.
Type of joint: Butt Joint.
Construction loads: As required by the Conditions of Development Consent. Design to be completed by accredited Structural Engineer. Such Design to be inserted on the drawings for approval during the DA process.

Certificate: Provide precast box culvert unit certificate of conformance with the following:
- Small culvert units: To AS 1597.1.
- Large culvert units: To AS 1597.2.

This is a HOLD POINT.

Marking: Mark each unit at time of manufacture with the following, using 75 mm high letters in an easily visible location which is hidden once the unit is installed:
- Type and size.
- Casting date.
- Manufacturer’s name.
- Inspection pass date.
- Batch number.

Durability
Exposure classification: Conform to the following:
- For small culvert units to AS 1597.1: As required by the Conditions of Development Consent. As per the approved CC drawings regarding exposure classification.
- For large culvert units to AS 1597.2: As required by the Conditions of Development Consent. As per the approved CC drawings regarding exposure classification.

Concrete cover: Conform to the following:
- Small culvert unit: To AS 1597.1 Table 2.3.
- Large culvert unit: To AS 1597.2 Table 2.4.

Strength
Minimum compressive strength: Conform to the following:
- For small culvert units to AS 1597.1: As required by the Conditions of Development Consent. As per the approved CC drawings regarding exposure classification.
- For large culvert units to AS 1597.2: As required by the Conditions of Development Consent. As per the approved CC drawings regarding exposure classification.

Dimensions and tolerances
Dimensions and tolerances: Conform to the following:
- Small culvert unit: To AS 1597.1 clause 2.8, 2.9 and Table 2.7.
- Large culvert unit: To AS 1597.2 clause 2.9, 2.11 and 2.12.

Sampling and testing
Routine sampling and testing: Supply and test precast box culvert units to conform with the following:
- Small culvert unit: To AS 1597.1 clause 3.4.
- Large culvert unit: To AS 1597.2 clause 5.
- Manufacturer’s quality system: To AS/NZS ISO 9001.

This is a WITNESS POINT.
Prototype load testing certificate: Provide certificate and test results for prototype proof load testing to the following:
- Small culvert unit: To AS 1597.1 Appendix G.
- Large culvert unit: To AS 1597.2 Appendix J.

This is a HOLD POINT.
3.4 IN SITU CONCRETE

General
In situ concrete: Conform to 0319 Minor concrete works for the concrete and reinforcement for cast-in situ base slabs.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Control of traffic: Conform to the following:
- Worksection 1101 Control of traffic: Traffic Guidance Scheme.

4.2 COFFER DAMS

General
Requirement: Construct a coffer dam as necessary for site specific conditions to allow for full diversion & dewatering of the construction area.

Construction of coffer dams
General: Provide coffer dams in conformance with the following:
- Sufficiently watertight to prevent damage, by percolation or seepage through the sides, of the concrete used in culverts.
- Founded sufficiently below the level of the culvert footings to prevent loosening of the foundation materials by water rising through the bottom of the excavation.
Bracing: Construct and brace coffer dams to prevent weakness or damage to the structure on their removal.
Forms: A coffer dam constructed to the size of the reinforced concrete invert slab can be used as side forms for the concrete.
Approval: Submit for approval the details of the coffer dam, formwork required, and proposed clearances. This is a HOLD POINT.

Specified clearances
Adjustment: Right or enlarge coffer dams which have tilted or moved laterally during sinking to provide the documented clearances.

Timber or bracing removal
Removal: Remove timber or bracing from the concrete and the backfill of the finished structure.
Completion: Remove coffer dams, including temporary piles, at least to the level of the culvert invert after completion of the structure. Ensure that no material associated with the coffer dam or dewatering can enter the culvert. This is a WITNESS POINT.

4.3 HANDLING, DELIVERY AND STORAGE

General
Handling: Provide for delivery and unloading.
Lifting: Provide lifting holes, galvanised lifting points or steel lifting eyes in the culvert units, link and base slabs.
Proprietary systems: Provide in conformance with manufacturer's specifications and recommendations.

Handling and loading: Handle and load precast box culvert units to prevent any damage to the units.
Delivery and storage: Do not transfer completed precast box culvert units from the place of manufacture until the following is achieved:
- 70% of the minimum concrete strength.
- Small culvert units: Cured to AS 1597.1 clause 2.6.3.
- Large culvert units: Cured to AS 1597.2 clause 2.7.

Inspection: Inspect batches of precast box culvert units for dimensional accuracy and defects following delivery to installation location. Conform to the following:
- Small culvert unit: To AS 1597.1.
4.4 EMBANKMENT

Pegging of culverts
Set out: Peg the centreline of the culvert at the inlet and outlet inverts and peg the extent of the clearing required. This is a HOLD POINT.

Diversion and disposal of water
Control any water: Divert and/or dispose of water from the works as required without causing damage to any portion of the works or surrounding properties due to this operation. Submit plan for managing any water for approval: This is a WITNESS POINT.

Excavation
Excavation: Conform to 1351 Stormwater drainage (Construction) and 1112 Earthworks (Roadways).
Trench width: If not shown otherwise on the drawings, the width of the base slab plus 150 mm minimum each side.
Bedding, support and backfill material: Unless otherwise documented, to 1351 Stormwater drainage (Construction).
Uniform surface correction: Provide mass concrete to form a uniform bearing surface at least 50 mm above the highest points of rock to correct over-excavation or uneven surfaces.
Line and level: Finish earth foundations to line and level to the underside of bedding shown on the drawings. Do not disturb material below this level.
Batter slopes: Evenly transitioned over 10 m length from the edge of the wingwall to match culvert wingwall slopes.

Excavate existing stream bed
Joining: Excavate inlet and outlet channels as shown on the drawings and extend to the existing stream bed to 1121 Open drains, including kerb and gutter.

4.5 FOUNDATIONS

Rock foundations
Level: Excavate foundations in rock neatly to the underside of the bedding as shown on the drawings.
Prepare: Thoroughly clean out all minor fissures and refill with concrete, mortar or grout. Remove all loose material.
Rock: If rock is encountered over part of the foundation, excavate the whole of the foundation to a depth of 300 mm below the level of the bottom of the base concrete slab.
Backfill: Replace and compact this additional excavation with backfill material to provide uniform bearing conditions. Conform to the following:
Small culverts: AS 1597.1 clause 4.3.
Large culverts: AS 1597.2 clause 6.3.

Bedding
General: Select bedding from the following alternatives: This is a HOLD POINT.
- Mass concrete bedding for cast in situ base slabs:

Or
- CRB20-2 bedding for cast in situ base slabs:
  . CRB20-2 material: To 1141 Flexible pavement base and subbase.
  . Lightly bound and compacted: To 1351 Stormwater drainage (Construction).
  . Dimensions: As shown on the drawings.
  . Place to the line and level of the underside of the base slab: ± 10 mm in level and ± 5 mm in line.
  . Finish: Smooth surface finish by screeding.

Or
- Foundation support for precast base slabs:
  . Small culverts: Select backfill to AS 1597.1.
  . Large culverts: Select backfill to AS 1597.2.
  . Compacted depth: > 150 mm.
4.6 INSTALLATION

General
Inlet and outlet invert levels: As shown on the drawings ± 10 mm and smooth, uniform gradient throughout each culvert length.
Installation: Conform to the following:
- Small culvert units: To AS 1597.1 clause 4, the drawings and this worksection.
- Large culvert units: To AS 1597.2 clause 6, the drawings and this worksection.

Cast in situ base slabs
Requirement: Construct cast in situ base slabs to the dimensions shown on the drawings and in conformance with this worksection.
Traffic: Prevent construction or public traffic over the base slab within 7 days of placement.
Tolerance: Conform to the following:
- Invert levels: - 10 mm, + 10 mm.
- Grade: 5 mm in 2.5 m (1 in 500).
- Plan position: ± 50 mm.
- Surface irregularities: < 5 mm abrupt and 8 mm over a 3 m straight edge.
Recesses: Form recesses to accommodate the walls of the precast crown units in the base slab to the dimensions shown on the drawings.
Minimum strength requirement: Install precast units after the base slab has attained a minimum compressive strength of 20 MPa. This is a WITNESS POINT.

Placement of units
Temporary plug: If required, seal the ends of the culvert with a temporary plug to exclude water, sand or other deleterious materials.
Cement mortar: 0.4:1:3 water: cement: sand ratio by mass.
Mortar bed in recess: Install precast crown units on a bed of cement mortar in the recesses in the base slab. Pack any gaps between the side walls and the sides of the recesses with cement mortar.
Voids: Seal lifting holes and but joints between the ends of units with cement mortar or grout of a consistency that ensures filling of the void.
Grout type: As required by the Conditions of Development Consent and as referenced to approved CC drawings.
Mortar bed on supports: Clean thoroughly the bearing areas of the supports before placement of top slabs on U-shaped units or link slabs on adjacent crown units and cover with a bed of mortar.
Thickness of mortar bed: > 5 mm after placement of precast units.
Lifting hooks: Cut lifting hooks and coat the exposed steel to prevent corrosion.

Coating material: As required by the Conditions of Development Consent and as referenced to approved CC drawings.
Multi-cell: In the case of multi-cell culverts, provide a gap between adjacent cells as shown on the drawings or typically 15 mm. Fill this gap with cement mortar or grout.
Curing of joints: Protect all mortar joints from the sun and cure in an approved manner > 48 hours prior to placing backfill.
Joint covering: Cover all external surfaces of joints between precast crown units, both laterally and longitudinally for the full length, and minimum 250 mm width, with strips of non-woven geotextile of minimum mass 270 grams/m² in conformance with AGPT04G/09.
Check inspection: Prior to backfill placing inspect and make good all seals, joints and levels. This is a HOLD POINT.

4.7 BACKFILL

General
Removal of formwork: Remove all bracing and formwork prior to backfilling.
Zones: Place selected backfill in the side zones of the box culverts and wingwalls, and to a depth of 300 mm in the overlay zone of the culverts.
Compaction: Compact in layers > 150 mm compacted thickness in conformance with the following:
- Small culverts: To AS 1597.1 clause 4.6.
- Large culverts: To AS 1597.2 clauses 6.5 and 6.6.

Ordinary backfill: Backfill the remainder of the excavation with ordinary embankment fill in conformance with 1112 Earthworks (Roadways) and the following:
- Small culverts: To AS 1597.1 clause 4.6.
- Large culverts: To AS 1597.2 clause 6.3.

Wingwalls: Place backfill against wingwalls no less than 21 days after casting unless otherwise directed. This is a WITNESS POINT.

Subsoil drain: Provide a subsoil drain enclosed in a seamless tubular filter fabric at the outer walls of the precast crown sections and at wingwalls as shown on the drawings and in conformance with 11172 Subsoil and foundation drains.

Balancing backfill: Place backfill layers simultaneously on both sides of the culvert with a maximum 600 mm level difference to avoid differential loading. Commence backfilling and compaction at the wall and proceed away from it. This is a WITNESS POINT.

Horizontal terraces: If the slopes bounding the excavation are steeper than 4H:1V, cut benches in the form of successive horizontal terraces at least 1 m in width before the backfill is placed.

### 4.8 COMPLETION

#### General

Requirement: Remove and replace a precast box culvert if required for any of the following reasons:
- Any culvert is not within tolerances true to line.
- The level or grade shows settlement of the culvert after installation.
- Damage occurs during backfilling, compaction or subsequent operations.

Flushing: Flush clean all culverts from end to end and maintain in proper working order until the completion of works.

#### Construction loading on culverts

Constraint: Prevent the passage of construction vehicles and plant over the culvert until 28 days after the casting of the base slab or until the compressive strength of the base slab concrete has reached 32 MPa. This is a HOLD POINT.

Construction vehicles or plant: Where construction vehicles or plant with axle loads > 50 t submit proposed procedures and method for approval. This is a HOLD POINT.

Loading restrictions: Provide construction vehicle loads on culverts for various design fill heights to conform with the following:
- Small culverts: To AS 1597.1 clause 4.7.
- Large culverts: To AS 1597.2 clause 6.7.

### 5 LIMITS AND TOLERANCES

#### Application

Summary: The limits and tolerances applicable to this worksection are summarised in Summary of limits and tolerances table.

#### Summary of limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection clause reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large culvert unit</td>
<td></td>
<td>Interpretations</td>
</tr>
<tr>
<td>- Span</td>
<td>1500 mm to 4200 mm</td>
<td></td>
</tr>
<tr>
<td>- Height</td>
<td>≤4200 mm</td>
<td></td>
</tr>
<tr>
<td>Small culvert unit:</td>
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<td></td>
</tr>
<tr>
<td>- Span</td>
<td>≤1200 mm</td>
<td></td>
</tr>
<tr>
<td>- Height</td>
<td>≤1200 mm</td>
<td></td>
</tr>
<tr>
<td>Water chloride ions</td>
<td>≤500 mg/L</td>
<td>Constituent materials</td>
</tr>
<tr>
<td>Surface irregularities</td>
<td>3 mm over the width of</td>
<td>Formed concrete surface</td>
</tr>
<tr>
<td></td>
<td>the surface</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Limits/Tolerances</td>
<td>Worksection clause reference</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------------------------------------</td>
</tr>
<tr>
<td>Surface irregularities maximum</td>
<td>5 mm over the width of the surface</td>
<td>Unformed concrete surface</td>
</tr>
<tr>
<td>Width of the base slab plus</td>
<td>Width of base slab plus 150 mm minimum each side</td>
<td>Excavation</td>
</tr>
<tr>
<td>Batter slope transition from edge of wingwall</td>
<td>10</td>
<td>Excavation</td>
</tr>
<tr>
<td>Rock excavation</td>
<td>Depth of 300 mm below the level of the bottom of the base concrete slab</td>
<td>Rock Foundations</td>
</tr>
<tr>
<td>Bedding alternatives:</td>
<td></td>
<td>Bedding for precast base slabs</td>
</tr>
<tr>
<td>- To line of underside of the base slab</td>
<td>± 5 mm</td>
<td></td>
</tr>
<tr>
<td>- To level of underside of the base slab</td>
<td>± 10 mm</td>
<td></td>
</tr>
<tr>
<td>- Compacted depth</td>
<td>&gt; 150 mm</td>
<td></td>
</tr>
<tr>
<td>Cast in situ base slabs:</td>
<td></td>
<td>Cast in situ base slabs</td>
</tr>
<tr>
<td>- Invert levels</td>
<td>± 10 mm</td>
<td></td>
</tr>
<tr>
<td>- Grade</td>
<td>5 mm in 2.5 m (1 in 500).</td>
<td></td>
</tr>
<tr>
<td>- Plan position</td>
<td>± 50 mm</td>
<td></td>
</tr>
<tr>
<td>- Surface irregularities:</td>
<td>&lt; 5 mm abrupt and 8 mm over a 3 m straight edge</td>
<td></td>
</tr>
<tr>
<td>- Minimum strength requirement before installation of precast unit</td>
<td>20 MPa</td>
<td></td>
</tr>
<tr>
<td>Cement mortar:</td>
<td></td>
<td>Placement of units</td>
</tr>
<tr>
<td>- Water:cement:sand ratio by mass</td>
<td>0.4:1:3</td>
<td></td>
</tr>
<tr>
<td>- Thickness of mortar bed</td>
<td>&gt; 5 mm</td>
<td>Placement of units</td>
</tr>
<tr>
<td>Gap between adjacent multi-cell culverts</td>
<td>15 mm</td>
<td></td>
</tr>
<tr>
<td>Protection of mortar joints</td>
<td>&gt; 48 hours before backfill</td>
<td>Placement of units</td>
</tr>
<tr>
<td>Depth of backfill in side zones</td>
<td>300 mm</td>
<td>Backfill</td>
</tr>
<tr>
<td>Compaction layers</td>
<td>&gt; 150 mm compacted thickness</td>
<td>Backfill</td>
</tr>
<tr>
<td>Backfill against wingwalls</td>
<td>≥21 days after casting.</td>
<td>Backfill</td>
</tr>
<tr>
<td>Backfill maximum level difference to avoid differential loading</td>
<td>600 mm</td>
<td>Backfill</td>
</tr>
<tr>
<td>Horizontal terraces requiring cut benches at least 1 m width before the backfill is placed.</td>
<td>&gt; 4H:1V</td>
<td>Backfill</td>
</tr>
<tr>
<td>Construction loading:</td>
<td></td>
<td>Completion</td>
</tr>
<tr>
<td>- Restriction on construction traffic after the casting of the base slab</td>
<td>28 days</td>
<td></td>
</tr>
<tr>
<td>- Compressive strength of the base slab concrete</td>
<td>32 MPa minimum</td>
<td></td>
</tr>
</tbody>
</table>
6 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

6.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay Items 1353.1 and 1353.2.
Lump Sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment:
Excavation for box culverts: Conform to 1351 Stormwater drainage (Construction).
Excavation for inlet and outlet channels: Conform to 1121 Open drains, including kerb and gutter.
Miscellaneous minor concrete work: Conform to 0319 Minor concrete works.
Ordinary embankment backfill: Conform to 1112 Earthworks (Roadways).
Cast-in situ headwalls and wingwalls: Conform to 1354 Drainage structures.
Subsoil drains: Conform to 1172 Subsoil and foundation drains.

Deductions
In situ concrete strength specified in 0319 Minor concrete works: Deductions made as follows:
- Scheduled rate of payment is reduced by 2% for each 1%, or fraction thereof, by which the strength of the specimen falls to reach the specified strength, up to a maximum deficiency of 10%.
- If the deficiency in strength exceeds 10%, the concrete represented by the specimens may be rejected, in which case no payment will be made.

6.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1353.1 In situ base slab</td>
<td>m³ of reinforced concrete in place. Volume to be calculated from length, width and depth of slab as shown on the Drawings or directed by the Superintendent</td>
<td>All cost associated with foundation preparation, bedding and all activities associated with the construction of the base slab, including the following types: -Lightly bound CRB20-2 -Concrete, reinforcement, formwork</td>
</tr>
<tr>
<td>1353.2 Precast concrete box culverts</td>
<td>Linear m of actual length installed for each size of box culvert as shown on the Drawings</td>
<td>All costs associated with supply, installation and jointing of the precast units including selected backfilling and testing of the units</td>
</tr>
</tbody>
</table>
1354 DRAINAGE STRUCTURES

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide drainage structures as documented including the following: headwalls, wingwalls, pits, gully pits, inspection pits, junction boxes/pits, drop structures, inlet and outlet structures, energy dissipators; batter drains and other supplementary structures as shown on the drawings.

Performance
Requirements: As required by the Conditions of Development Consent.

Design

- design details and all the design parameters for the project design. Designer: to RP Eng/CP Eng standard to authorise design by signature.

Authority requirements: As required by the Conditions of Development Consent including Fisheries requirements.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following work section(s):
- 0136 General requirements (Construction).
- 0161 Quality (Construction).
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation.
- 1112 Earthworks (Roadways).
- 1121 Open drains, including kerb and gutter.
- 1351 Stormwater drainage (Construction).
- 1352 Pipe drainage.
- 1353 Precast box culverts.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this work section by reference:

Note: Only the most current standards are to be used

AS 1012-Various
AS 1379
AS 1478
AS 1478.1
AS/NZS 1554
AS/NZS 1554.3
AS 1657
AS 1726
AS 2758
AS 2758.1
AS 3600
AS 3610
AS 3610.1
AS 3735
AS 3972
AS 3996
AS/NZS 4671

Methods of testing concrete
Specification and supply of concrete
Chemical admixtures for concrete, mortar and grout
Admixtures for concrete
Structural steel welding
Welding of reinforcing steel
Fixed platforms, walkways, stairways and ladders - Design, construction and installation
Geotechnical site investigations
Aggregates and rock for engineering purposes
Concrete aggregates
Concrete structures
Formwork for concrete
Documentation and surface finish
Concrete structures retaining liquids
General purpose and blended cements
Access covers and grates
Steel reinforcing materials

©AUS-SPEC (Oct 12) 1 April 2015
AS 5100-Various Bridge design
NP: PCH Precast concrete handbook

**Other publications**
Note: Only the most current standards are to be used

Austroads
AGPT04G Guide to geotextiles – Geotextiles and geogrids

### 1.4 INTERPRETATION

**Definitions**
General: For the purposes of this worksection the following definitions apply:

- **Drainage structures**: Devices to control stormwater flowing into and through a stormwater drainage system including culverts, inlet and outlet structures, junction boxes, gully pits, drop structures, headwalls, wingwalls, energy dissipaters and ancillary hardware such as grates, frames and step irons as well as subsurface drainage pipes at pits, headwalls and wingwalls.

- **Selected backfill**: The material obtained from excavation of the pipe trench or elsewhere with a particle size not greater than 75 mm, and which conforms with the soil classes defined in AS 1726.

- **RMS- Roads and Maritime Services**.

### 1.5 SUBMISSIONS

**Approval**
Submissions: To the Superintendent's approval.

### 1.6 HOLD POINTS AND WITNESS POINTS

**Notice**
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS POINT table.

**HOLD POINTS table**

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precast units</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General – Product drawings</td>
<td>Submit details of precast or proprietary items for approval</td>
<td>1 working day</td>
<td>Superintendent</td>
</tr>
<tr>
<td>General – Quality</td>
<td>Submit quality test results.</td>
<td>3 working days before delivery</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation</td>
<td>Excavation and compaction of foundation as documented</td>
<td>1 working day</td>
<td>Superintendent &amp; Councils Engineering Development Officer</td>
</tr>
<tr>
<td>Headwalls and wingwalls</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General – Rock foundations</td>
<td>Submit details of cut-off walls in rock</td>
<td>1 working day</td>
<td>Superintendent</td>
</tr>
<tr>
<td><strong>Backfill</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Commencement</td>
<td>Obtain approval for commencement</td>
<td>1 workday day</td>
<td>Superintendent</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table**

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pits and junction boxes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precast units</td>
<td>Give notice of installation of precast pits and junction boxes</td>
<td>1 week</td>
</tr>
</tbody>
</table>
2  PRE-CONSTRUCTION PLANNING

2.1  SCHEDULING

Program of works
General: Program the works as follows:
- Materials: Arrange the program for compliance and usage of component and materials.
- Authorities: Arrange approvals and confirm environmental requirements from local authorities.
- Constraints: Incorporate HOLD POINTS and WITNESS POINTS.

3  MATERIALS

3.1  CONSTITUENT MATERIALS

Cement
Standard: To AS 3972.
Type: Do not use high alumina cement.

Aggregates
Standard: To AS 2758.1.

Water
Standard: To AS 1379.
Quality: Provide clean water, free from oil, acid, alkali, organic or vegetable matter with not more than 500 mg/l of chloride ions.

Other
Chemical admixtures: To AS 1478.1.

Reinforcement
Standard: To AS/NZS 4671.
General: Clean and free from harmful matter e.g. loose mill scale, loose rust, oil, grease and retarders. Ensure there is no pitting.
Corrosion protection: To AS 3600 clause 17.2.
Structural welding: To AS/NZS 1554.3.

Cast-in items
Cast in inserts: Provide structural steel cast in lifting items in conformance with the drawings.
Protective coating: As required by the Conditions of Development Consent.

3.2  FORMWORK

Formed concrete surface
Requirement: Conform to the following:
- Smooth, dense and dust free concrete finish.
- Unobtrusive form joint marks.
- No blowholes deeper than 5 mm.
- Class 3 formwork to AS 3610.1.
- Surface irregularities: Maximum 3 mm over the width of the surface.

Unformed surface
Requirement: Conform to the following:
- Wood float to a uniform surface without pitting or cavities.
- Surface irregularities: Maximum 5 mm over the width of the surface.
3.3 IN SITU CONCRETE

General
In situ concrete: Conform with 0319 Minor concrete works for the concrete and reinforcement for cast-in situ structures.

3.4 PRECAST CONCRETE

General
Concrete: To AS 3600 and AS 1379.
Testing: To AS 1012.
Casting: Do not remove precast units from casting mould until the concrete compressive strength > 15 MPa.

Durability
Exposure classification: As required by the Conditions of Development Consent.[complete/delete]
Concrete cover: To AS 3600.

Strength
Minimum compressive strength: As required by the Conditions of Development Consent.

3.5 ACCESS COVERS AND FRAMES

Specification
Access covers and frames: To AS 3996 and the Access covers and frames schedule.
Ductile iron cover size:
- Width: Parallel to the lifting ends and undercut.
- Length: Parallel to the direction of cover removal.

Infill material: Bond tile or paver to the concrete bed with an epoxy mortar.
Proprietary products: To the manufacturer’s recommendations.

Access covers and frames schedule

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Cover or Frame 1</th>
<th>Cover or Frame 2</th>
<th>Cover or Frame 3</th>
<th>Cover or Frame 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load class</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Size</td>
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<tr>
<td>Handling</td>
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</table>

Note: Cover or frame number as per drawings.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Control of traffic: To 1101 Control of traffic.

4.2 PRECAST UNITS

General
Product drawings: For any precast item, including proprietary items, not detailed in the drawings, submit the following:
- Product drawings.
- Method of manufacture, testing and installation including clearance to pit shaft ends, pipe to pipe jointing and step iron positioning

This is a HOLD POINT.

Substituting precast units for cast in situ units: Submit detailed drawings and complete details of installation procedures for approval.

Quality: Submit test results for all units prior to delivery to the works. This is a HOLD POINT.

Handling, delivery and storage
Handling and installation: Handle and install precast units, including kerb inlet lintels, to conform with the manufacturer’s instructions.

Marking
Identification marking: At the time of manufacture, clearly mark each precast unit with the following information:
- Date of manufacture.
- Manufacturer’s name or registered mark and the location of manufacture.
- Maximum mass of unit in kg.
- Batch number.
- Inspection status.

Height of letters: 75 mm.

Location of marking: Easily visible but hidden once the unit is installed.

4.3 INSTALLATION

General
Members subject to traffic and earth loads: To AS 5100.
Water retaining structures with a capacity > 25000 L: To AS 3735.
Water retaining structures with a capacity ≤25000 L: To AS 3600.
Other concrete components: Conform to AS 3600.
Program: Install drainage structures as soon as possible and not later than 14 days after the installation of associated pipes, box culverts or open drains.
Location: As shown on the drawings.
Horizontal tolerance: ± 25 mm.
Inlet and outlet invert levels: As shown on the drawings ± 10 mm.

Excavation
Bedding: Excavate and compact the foundation to conform with 1351 Stormwater drainage (construction). This is a HOLD POINT.

Foundation
Preparation: Dewater and wash clean of contaminants in preparation for concreting.
Pour concrete bedding; Dampen the surface of the foundation and place a layer of concrete > 50 mm thick over the excavated surface and finish to a smooth, even surface.

Joints and seals
Location: Provide an isolation joint where a drainage structure abuts a structure or concrete pavement.
Isolation joint: 10 mm wide approved preformed jointing filler.
Sealing: Effectively seal joints and connection points against the ingress of water and other kinds of material with cement mortar 1:3 general purpose cement: sand ratio.

Locating drainage structures
Arrangement: Unless otherwise shown on the drawings, construct headwalls and pits parallel to the road centreline and wingwalls at 135° to the headwall.
Skewness: If the culvert is laid skew to the road, splay the wingwalls and headwalls so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall.
Dissipaters: Construct as shown on the drawings.
Trash racks: If shown on the drawings, construct trash racks with access for machine removal of accumulated debris.
Rung ladders and step irons
Drop structures > 600 mm deep: Install an individual rung ladder or step iron on one internal wall for the full depth of the structure to conform to AS 1657.
Tolerance: Conform to the following:
- The top of the uppermost rung: ≤500 mm below the top of the pit.
- The top of the bottom rung: ≥300 mm and ≤500 mm above the invert of the pit.
- Rung spacings: 300 mm ± 50 mm.
Fixing: Conform to the following:
- Fix step irons firmly within the formwork before placing the concrete for the pit walls.
- Provide blockout formers to make recesses in the concrete to receive the arms of the step irons.
- Install at a later date by drilling the pit wall.
- Drill holes using a rotary masonry bit or similar. Do not use percussion tools to form the hole for the step iron.
- Use epoxy resin in conformance with the step iron and epoxy resin manufacturer’s recommendations.
- Ensure that no movement of the step irons occurs until the epoxy resin has reached the specified strength.

4.4 HEADWALLS AND WINGWALLS

General
In situ concrete: To 0319 Minor concrete works and the drawings.
Batter retention: Construct the wingwalls to retain the batters as shown on the drawings.
Rock foundations: If rock is encountered at the bottom of excavations for wingwalls and headwalls, submit for approval, a proposal to reduce the depth of cut-off walls in uniform rock over the full width of the foundations. This is a HOLD POINT.
- Depth: > 150 mm into sound rock.

Weepholes
Detail: Provide weepholes as shown on the drawings.
Requirement: Place broken stone or river gravel to 1351 Stormwater drainage (construction) as follows:
- Height: > 450 mm above the bottom of the weephole.
- Plan area: > 600 mm along the wall and 300 mm out from the wall located centrally about the weephole.
Geotextile: Enclose the broken stone or river gravel with geotextile filter fabric in conformance with AGPT04G or equivalent areas of geocomposite.

4.5 PITS AND JUNCTION BOXES

Precast units
Knockouts: Do not provide standard precast pit base units with thinned wall sections on all 4 sides. Provide base units and other riser units to suit the design configuration of the particular pit with preformed knockouts only where required.
Notice: Give notice before installation of precast pits and junction boxes. This is a WITNESS POINT.

Construction
Details: Construct all new pits to accept access covers, gully grates and frames to AS 3996 and to the details shown on the drawings.
Concrete: Unless otherwise shown on the drawings, conform to the following:
- Strength: > 32 MPa.
- Aggregate size: > 12 mm.
Access cover and pit: Locate so that removal of the cover is not obstructed by a wall, kerb or other fixed item.
Existing pits: Modify existing pits only if shown on the drawings.
Finished level: Flush with the finished level of the surrounding area ± 3 mm.
Full depth rock excavation: If the full depth of the excavation is in sound rock, submit for approval to omit part of the concrete lining of gully pits and sumps and to construct a neatly formed pit of the required dimensions. Construct in concrete the wall of the pit adjacent to and parallel to the road. This is a WITNESS POINT.

Inlet and outlet pipes: Cast ends of inlet and outlet pipes into the pit walls.

Subsoil drain: Provide subsoil drains for the pits or headwalls to 1172 Subsoil and foundation drains.

Access covers and frames

Fit and seals may be compromised: Covers and frames are matched items. Do not switch.

Tight fit: Make sure there is no excavated or other material between cover and frame to compromise seals and service life.

Proprietary access covers: Conform with the manufacturer’s recommendations, including any infill requirements for the covers.

Bulkheads

Location: If the pipe gradient of the line > 5%, construct concrete bulkheads on stormwater drainage pipe lines. Spacings and details as shown on the drawings.

4.6 BACKFILL

General

Commencement: Do not backfill against cast in situ concrete drainage structures within 14 days of placing the concrete or until compressive strength > 15 MPa unless otherwise approved. This is a HOLD POINT.

Selected backfill: Place selected backfill against the full height of the vertical faces of structures for a horizontal distance equal to one-third the height of the structure, or as shown on the drawings.

Loading: Prevent excessive surcharge loading against vertical surfaces during the backfilling.

Horizontal terraces: If the sides of the excavation are steeper than 4H:1V, cut benches in the form of successive horizontal terraces at least 600 mm in width, before the backfill is placed.

Balance: Backfill on both sides of the structure alternately in layers to avoid unbalanced forces on the structure.

Compaction: To 1351 Stormwater drainage (Construction). Commence backfilling and compaction at the wall.

4.7 COMPLETION

General

Requirement: Remove and replace any drainage structure if required for any of the following reasons:
- Not true to line or level.
- Shows settlement after laying.
- Damaged during backfilling, compaction or subsequent operations.

5 LIMITS AND TOLERANCES

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/tolerances</th>
<th>Clause Worksection reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formed concrete surface:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- No blowholes</td>
<td>&lt; 5 mm</td>
<td>Formwork</td>
</tr>
<tr>
<td>- Surface irregularities</td>
<td>&lt; 3 mm over the width of the surface</td>
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<tr>
<td>Unformed surface:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Surface irregularities</td>
<td>&lt; 5 mm over the width of the surface</td>
<td></td>
</tr>
<tr>
<td>Precast units compressive strength of concrete</td>
<td>&gt; 15 MPa</td>
<td>Precast concrete</td>
</tr>
<tr>
<td>Identification marking lettering</td>
<td>75 mm high</td>
<td></td>
</tr>
<tr>
<td>Horizontal tolerance</td>
<td>± 25 mm</td>
<td>Installation</td>
</tr>
<tr>
<td>Activity</td>
<td>Limits/tolerances</td>
<td>Clause Worksection reference</td>
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<tr>
<td>---------------------------------------------------</td>
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<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Inlet and outlet invert levels</td>
<td>± 10 mm</td>
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<tr>
<td>Foundation:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Mass concrete bedding depth</td>
<td>&gt; 50 mm</td>
<td></td>
</tr>
<tr>
<td>Joints and seals:</td>
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<td></td>
</tr>
<tr>
<td>- Thickness</td>
<td>10 mm</td>
<td></td>
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<tr>
<td>- Cement mortar</td>
<td>1:3 general purpose cement:sand</td>
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</tr>
<tr>
<td>Wingwalls location</td>
<td>135° to the headwall</td>
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<tr>
<td>Step irons:</td>
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<tr>
<td>- Distance from top of the uppermost rung to top of pit</td>
<td>&lt; 600 mm</td>
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<tr>
<td>- Distance of top of the bottom rung above the invert of the pit</td>
<td>≥300 mm and ≤500 mm</td>
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<tr>
<td>- Rung spacings</td>
<td>300 mm ± 50 mm</td>
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<tr>
<td>Headwalls and wingwalls – cut off walls depth into sound rock</td>
<td>&gt; 150 mm</td>
<td>Headwalls and wingwalls</td>
</tr>
<tr>
<td>Weepholes:</td>
<td></td>
<td></td>
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<tr>
<td>- Height of gravel above the bottom of the weephole</td>
<td>&gt; 450 mm</td>
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</tr>
<tr>
<td>- Plan area of gravel centrally about the weephole</td>
<td>&gt; 600 mm along the wall and 300 mm cut from the wall located</td>
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</tr>
<tr>
<td>Concrete construction:</td>
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<td>Pits and junction boxes</td>
</tr>
<tr>
<td>- Strength</td>
<td>&gt; 32 Mpa</td>
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<tr>
<td>- Aggregate size</td>
<td>&gt; 12 mm.</td>
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</tr>
<tr>
<td>- Finished level</td>
<td>± 3 mm. level of the surrounding area</td>
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</tr>
<tr>
<td>- Compressive strength</td>
<td>&gt; 15 MPa</td>
<td>Backfill</td>
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<td>Headwalls and wingwalls – cut off walls</td>
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</tr>
<tr>
<td>- Depth into sound rock</td>
<td>&gt; 150 mm</td>
<td>Headwalls and wingwalls</td>
</tr>
<tr>
<td>Foundation for concrete bases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Mass concrete bedding depth</td>
<td>&gt; 50 mm</td>
<td>Foundation for concrete basis</td>
</tr>
</tbody>
</table>

6 MEASUREMENT AND PAYMENT

Note: This item is an Optional condition for Development. Required for Council Project.

6.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, as shown on the Drawings and Pay Items 1354.1 to 1354.3 inclusive.
Lump sum prices: Not acceptable.
Unpriced items: For each unpriced item listed in the Schedule of Rates, make due allowance in the prices of other items.

Methodology
The following methodology will be applied for measurement and payment: The cost of all work, materials and equipment is included in the Schedule rate for each Pay Item.
- Excavation: To 1351 Stormwater drainage (Construction).
## 6.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1354.1 Supply and place headwalls and wingwalls</td>
<td>$m^3$ of concrete in place. Volume calculated from the dimensions on Drawings, specified or directed by Superintendent.</td>
<td>All costs associated with supply and placing of in situ concrete including reinforcement in place including joints or backfilling.</td>
</tr>
<tr>
<td>1354.2 Supply and place pits, dissipators, channel basins and other supplementary structures</td>
<td>'Each' completed structure as shown on the Drawings, specified or directed by Superintendent.</td>
<td>All costs associated with the structures including cast in metal work, precast items frames, grates; lintels; tids; backfilling.</td>
</tr>
<tr>
<td>1354.3 Supply and place bulkhead structures</td>
<td>'Each' completed bulkhead as shown on the Drawings, specified or directed by Superintendent.</td>
<td>All costs associated with bulkhead structures including reinforcement and backfilling.</td>
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</table>