# REVISION HISTORY

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<th>Ed/Rev Number</th>
<th>Clause Number</th>
<th>Description of Revision</th>
<th>Authorised By</th>
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<td>Ed 1/ Rev 0</td>
<td></td>
<td>Review of the Engineering Guidelines following public exhibition</td>
<td>Executive</td>
<td>October 2014</td>
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<tr>
<td>Ed 1/ Rev 1</td>
<td>1141 Section 3.1</td>
<td>Review base and sub-base specification to bring in line with RMS and IPWEA</td>
<td>Manager, Asset Management</td>
<td>30/05/2016</td>
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<td></td>
<td>1141 Section 3.4</td>
<td>Refer only to RMS R73 for the construction of bound base and sub-base material</td>
<td>Manager, Asset Management</td>
<td>30/05/2016</td>
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<tr>
<td>Ed 1/ Rev 2</td>
<td></td>
<td>Minor updates to formatting and font consistency</td>
<td>Manager, Asset Management</td>
<td>22/05/2018</td>
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<tr>
<td>Ed 1/ Rev 2</td>
<td>1141 Section 3.1 p.248</td>
<td>Unbound base and subbase materials: The designation of recycled materials has been expanded to allow use of recycled crushed glass fines that meet RMS 3051 specification. This now allows road base mix to contain up to 10 per cent glass fines</td>
<td>Manager, Asset Management</td>
<td>22/05/2018</td>
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<td>1351 Section 3.2 p.421</td>
<td>Bedding, support and backfill material: Gradation of recycled crushed glass fines must meet Table 6 of AS3725. AS3725 Table 6 provides strict mechanical and chemical properties for fines intended for use in stormwater drainage bedding, support and backfill applications</td>
<td>Manager, Asset Management</td>
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1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide labour, materials, plant and equipment to construct the Works as documented.

Location
Description: [complete/delete]

Type of contract
Quality system: [complete/delete]

Method of payment: [complete/delete]

Special requirements: [complete/delete]

Performance
Requirements: [complete/delete]

Design
Designer: [complete/delete]

Authority requirements: [complete/delete]

1.2 PRECEDENCE

General
Worksections and standards:
- Requirements of other worksections of the specification override conflicting requirements of this worksection.
- The technical requirements of the worksections override conflicting requirements of their referenced documents.
- The requirements of referenced documents are minimum requirements.

1.3 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction) and/or 0167 Integrated management.
- 1102 Control of erosion and sedimentation (Construction).
- 1112 Earthworks (Roadways).
- 1195 Boundary fences for road reserves.
- 1351 Stormwater drainage (Construction).

Cross referencing
Within the text:
- Worksection titles are indicated by *Italicised* text.
- Clause titles are indicated by **BOLD** text.

1.4 REFERENCED DOCUMENTS

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

*Australian standards*
- AS 1319-1994 Safety signs for the occupational environment
- AS 1348-2002 Glossary of terms - Roads and traffic engineering
- AS/NZS 1680 Interior lighting
- AS/NZS 1680.2-1997 Industrial tasks and processes
- AS 2670 Evaluation of human exposure to whole body vibration
- AS 2670.1-2001 General requirements (ISO 2631-1:1985)
1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- AS: Australian Standard.
- CAD: Computer Aided Design.
- ICSM: Intergovernmental Committee on Surveying & Mapping
- NZS: New Zealand Standard.
- RMS: Root mean square.
- TBS: To Be Supplied.

Definitions
General: For the purposes of this contract the definitions given in AS 1348, AP-C87 and the following apply:
- Authorities: Includes Agencies.
- Documented: Documented, as documented and similar terms mean contained in the contract documents.
- Geotechnical site investigation: The process of evaluating the geotechnical characteristics of the site in the context of existing or proposed construction.
- Give notice: Give notice, submit, advise, inform and similar expressions mean give notice (submit, advise, inform) in writing to the Superintendent.
- Manufacturers’ and suppliers’ recommendations: Recommendations, instructions, requirements, specifications (and similar expressions) provided in written or other form by the manufacturer relating to the suitability, use, installation, storage and/or handling of a product.
- Obtain: Obtain, seek and similar expressions mean obtain (seek) in writing from the Superintendent.
- Permanent marks: Survey control marks that are permanent by nature and are uniquely defined in the state control survey. Also known as State survey marks (SSM) or Bench marks (BM).
- Principal: Principal has the same meaning as Owner, Client and Proprietor and is the party to whom the Contractor is legally bound to construct the Works. The primary obligation of the Principal is to make payments to the Contractor.
- Professional engineer: A person who is listed or eligible for listing on the National Professional Engineers Register (NPER) and has appropriate experience and competence in the relevant discipline at the relevant time.
- Proprietary: Identifiable by naming manufacturer, supplier, installer, trade name, brand name, catalogue or reference number.
- Provide: Provide and similar expressions mean supply and install and include development of design beyond that documented.
- Registered testing authority:
  - An organisation registered by NATA to test in the relevant field; or
  - An organisation outside Australia registered by an authority recognised by NATA through a mutual recognition agreement; or
  - An organisation recognised as being a Registered Testing Authority under legislation at the time the test was undertaken.
- Required: Required by the documents, the Local Council or statutory Authorities.
- If required: A conditional specification term for work which may be shown in the documents or be a legislative requirement.
- Superintendent: Superintendent has the same meaning as Contract Administrator or Principal’s representative. The Superintendent may be party to the contract or appointed by the Principal to administer the contract. The powers, duties and authorities of the Superintendent are covered in the contract. These can be changed in writing at any time during the contract.

- Supply: Supply, furnish and similar expressions mean supply only.

- Tests:
  . Completion tests: Tests carried out on completed installations or systems and fully resolved before the date for practical completion, to demonstrate that the installation or system, including components, controls and equipment, operates correctly, safely and efficiently, and meets performance and other requirements. The Superintendent may direct that completion tests be carried out after the date for practical completion.
  . Pre-completion tests: Tests carried out before completion tests.
  . Production tests: Tests carried out on a purchased item, before delivery to the site.
  . Site tests: Tests carried out on site.
  . Type tests: Tests carried out on an item identical with a production item, before delivery to the site.

- Tolerance: The permitted difference between the specified value and the upper limit and the lower limit of dimension, value or quantity.

- Verification: Provision of evidence or proof that a performance requirement has been met or a default exists.

1.6 SUBMISSIONS

Acceptance criteria
General: All submissions will be subject to the approval of the Superintendent.

Alternative construction
Detailed working drawings: If a tender based on the use of alternative material, design or method of construction is accepted, prepare and submit detailed working drawings, design calculations and specifications for the alternative, together with details of necessary alterations to this worksection.
Certification: Prepare and certify design and construction documents by a Professional Engineer experienced in that type of design.
Submission: Submit documents at least four weeks before construction of the relevant part of the work is scheduled to commence. Do not commence work on that part without approval. This is a HOLD POINT.
Costs: Pay the cost of submissions and evaluations and tests of proposed alternatives, whether subsequently accepted as a variation or not. The costs will be calculated at the current charge-out rates of the relevant consultant(s).
Substitution: If alternatives to the documented products, methods or systems are proposed, submit sufficient information to permit evaluation of the proposed alternatives, including the following:
  - Reasons for the proposed substitutions.
  - Statement of the extent of revisions to the contract documents.
  - Statement of the extent of revisions to the construction program.
  - Statement of consequent alterations to other parts of the Works.
  - Statement of cost implications including costs outside the contract.
  - Evidence that the performance is equal to or greater than that specified.
  - Evidence of conformity to a referenced document.
  - Essential technical information, in English.
  - Samples.
Availability: If the documented products or systems are unavailable within the time constraints of the construction program, submit evidence.
Criteria: If the substitution is for any reason other than unavailability, submit evidence that the substitution:
  - Is of net enhanced value to the Principal.
- Is not prohibited by the Contract documents and is as effectual as the identified item, detail or method.

**Execution details**

Construction management: Prepare the following for submission:

- [complete/delete]

**Materials**

Product certification: Submit evidence of product conformance with relevant product certification schemes.

Product data: For proprietary equipment, submit the manufacturer’s product data as follows:

- Technical specifications and drawings.
- Type-test reports.
- Performance and rating tables.
- Recommendations for installation and maintenance.

OHS: Hazardous materials storage and procedure to counteract spillages.

To be supplied: Nominated TBS items program.

**Type tests**

Requirement: Provide all test results and survey records promptly if requested.

**Working drawings**

Working documentation: Provide 2 sets of CAD working drawings and any supporting calculations before the scheduled commencement of the work concerned.

Approval to proceed: Do not commence work until a set of working drawings has been returned with written authorisation to proceed. The Superintendent’s written authorisation to proceed does not relieve the Contractor of the responsibilities for the design (where applicable) and construction of the Works in conformance with the Contract.

Revisions: Promptly attend to any required revisions to drawings or calculations and resubmit 4 sets of the revised drawings and calculations.

Authorised variations: Obtain written authorisation for the variation from the Superintendent to proceed. Submit 2 sets of revised working drawings.

**Work-as-executed drawings**

Submission: Provide marked up and certified work-as-executed drawings for the whole of the Contract before issue of the Final Certificate.

Contract drawings: Digital contract drawings supplied by Superintendent at no cost for mark up.

Roadworks: Mark up in red and certify all changes to the contract drawings and actual values of all levels, signed by the surveyor.

Bridgeworks: Mark up in red and certify all changes to the contract drawings, including variations to levels, dimensions, concrete, reinforcement, prestressing and other materials, all non-conformances accepted without rectification, suppliers and model numbers of bearings and proprietary joints and type of barrier railings installed where both steel and aluminium alternatives are detailed.

Public utilities: Record as required by the worksections.

### 1.7 INSPECTION

**Notice**

General: Give notice so that inspection may be made of the following:

<table>
<thead>
<tr>
<th>Summary of HOLD POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clause title/Item</strong></td>
</tr>
<tr>
<td>Submissions</td>
</tr>
<tr>
<td>Signage</td>
</tr>
<tr>
<td>Survey control</td>
</tr>
<tr>
<td>Survey control</td>
</tr>
<tr>
<td>Environmental planning</td>
</tr>
</tbody>
</table>
### Utilities and Authorities
- **Requirement**: Confirmation of relocation
- **Notice for inspection**: 3 working days before new work
- **Release by**: Principal Certifying Authority

### Site facilities
- **Requirement**: Positioning of services
- **Notice for inspection**: 1 week before installing services
- **Release by**: Principal Certifying Authority

### Summary of WITNESS POINTS – Off-site activities

<table>
<thead>
<tr>
<th>Clause title/item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Items to be supplied (TBS) by the Principal</td>
<td>Notice of time of delivery</td>
<td>2 working days</td>
</tr>
<tr>
<td>Pipe culverts supplied by the Principal</td>
<td>Notice of time of delivery</td>
<td>30 working days</td>
</tr>
</tbody>
</table>

### Summary of WITNESS POINTS – On-site activities

<table>
<thead>
<tr>
<th>Clause title/item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage of fuels and chemicals</td>
<td>Approval for toxic chemicals</td>
<td>1 week</td>
</tr>
<tr>
<td>Utilities and Authorities</td>
<td>Conflict with drawings</td>
<td>1 week</td>
</tr>
<tr>
<td>Protection of services</td>
<td>Notice to divert</td>
<td>3 working days</td>
</tr>
<tr>
<td>Programming utility adjustments</td>
<td>Notice of date of completion of associated work</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Adjoining works</td>
<td>Notice of commencement of works</td>
<td>1 week</td>
</tr>
</tbody>
</table>

## 2 PRE-CONSTRUCTION PLANNING

### 2.1 CONTRACT ADMINISTRATION

**Insurance**

Requirement: Provide evidence of currency for Workers Compensation Insurance, Insurance of the Works or Public Liability Insurance.

*Superintendent’s representative: [complete/delete]*

## 3 CONSTRUCTION REQUIREMENTS

### 3.1 GENERAL

**Contractual relationships**

Contractual responsibilities: Responsibilities and duties of the Principal, Contractor and Superintendent are not altered by requirements in the referenced documents.

Directions: All instructions are directed to the Contractor unless noted otherwise.

**Approvals**: Obtain all approvals from the Superintendent unless noted otherwise.

**Current editions**

General: Use referenced documents (including test methods) which are the editions, with amendments, current 3 months before the closing date for tenders, except where other editions or amendments are required by statutory Authorities.

*Site copies: [complete/delete]*

**Drawings**

Contract documents: The issued drawings which form part of the Contract documents are bound in a separate volume.

**Contract documents**

General: Layouts of service lines, plant and equipment shown on the drawings are diagrammatic only, except where figured dimensions are provided or calculable.

Before commencing work:
- Obtain measurements and other necessary information.
- Coordinate the design and installation in conjunction with all trades.
Spot levels: Documented spot levels take precedence over documented contour lines and ground profile lines.

**Inspections**
Concealment: If notice of inspection is required for parts of the Works that will be concealed, advise when the inspection can be made before concealment.
Light level requirements: To AS/NZS 1680.2.4.

**Adjoining works**
Adjoining works: Make sure that there are smooth junctions with the existing or adjoining work.
Adjoining property owners: Give notice to all adjoining property owners of the commencement of the Works.

**Materials**
Manufacturers’ or suppliers’ recommendations: Provide, including select, if no selection is given, transport, deliver, store, handle, protect, finish, adjust and prepare for use, manufactured items in conformance with the current written recommendations and instructions of the manufacturer or supplier.
Proprietary items/systems/assemblies: Assemble, install or fix in conformance with the current manufacturers’ or suppliers’ recommendations
Project modifications: Advise of activities that supplement, or are contrary to, manufacturers’ or suppliers’ recommendations.
Sealed containers: If materials or products are supplied by the manufacturer in closed or sealed containers or packages, bring the materials or products to point of use in the original containers or packages.

**Materials sources policy:** [complete/delete]

### 3.2 PROJECT SPECIFIC REQUIREMENTS

**Site access**
Contractor’s access to site: [complete/delete]
Public access to site: [complete/delete]

**Working area**
Designated areas: [complete/delete]

Working areas: Restrict construction working areas and areas for temporary site facilities such as the storing of materials, use of plant and erection of sheds, to areas documented on the drawings.
Do not work or occupy areas outside of the designated areas.
Security: Take security measures for the safe-keeping of any plant, equipment, tools, materials or other property. Submit proposals for any boundary security fencing for approval.
Temporary fencing: Provide and maintain temporary fencing and warning signage during the contract to prevent unauthorised entry into the property.
Existing fencing: Reinstate the existing fencing and remove temporary fencing before the date of practical completion.

**Date for possession of the site:** [complete/delete]

**Site restraints**
Special site conditions: [complete/delete]
Reports supplied for information only: [complete/delete]

Status: Reports supplied for information only can not be relied upon as contractual.

### 3.3 WORK NOT IN CONTRACT

**Work by others**
Program precautions: Coordinate the Works with simultaneous and/or adjacent work by others and liaise with other Contractors and Authorities to avoid disruption, delays and possible conflict.
Access: If required, by the Superintendent, allow free access for completion of any work by others.

**Items to be supplied (TBS) by the principal**
TBS by Principal: To **Items to be supplied by Principal schedule**.
TBS: Items listed in Annexure A are supplied, delivered and unloaded by the Principal free of cost to the Contractor at nominated points.
Time of delivery: Give notice of the required time of delivery for TBS items. This is a **WITNESS POINT**.

Damaged or defective: Give notice of any TBS item found damaged or defective within 2 days of taking delivery of such item. If the Contractor does not report damage or defect it is deemed that the TBS item was free from damage or defect when received and the Contractor is responsible for any replacement or making good as directed by the Superintendent.

Storage: Store, protect and insure of all TBS Items received.

**Pipe culverts supplied by the Principal**

Time of delivery: Give 30 days notice of the time delivery. This is a **WITNESS POINT**.

Supplied: Pipe culverts are supplied by the Principal at no cost to the Contractor for the actual length laid of pipe culvert required under the contract.

Additional pipe culverts: If any pipe culverts are required in addition to those supplied, it is the responsibility of the Contractor to supply at no cost to the Principal.

Program: Complete works by the programmed dates listed in Annexure A to Relocation/alteration to services (by Principal) Schedule.

### 3.4 SITE INVESTIGATION

**Geotechnical and environmental reports**

General: The geotechnical and environmental site investigation report provided is for information only. The provided geotechnical information, including information on contaminants, is information on the nature of the ground at each tested part. It is not a complete description of conditions existing at or below ground level.

Contractors responsibility: Examine and assess the following:

- Geotechnical information and the site to determine the impact on the construction of the Works.
- The in situ moisture content likely at the actual time the work is carried out.

### 3.5 SIGNAGE

**General**

All signs: Submit all safety and project signs for approval before sign manufacture or purchase. This is a **HOLD POINT**.

**Safety signs**

Requirement: Provide appropriate regulatory, hazard, emergency information and fire signs to AS 1319.

Location: Display safety signs at prominent locations around the working areas and temporary site facilities including:

- Mandatory signs for personal protective equipment such as eye, head and foot protection.
- DANGER signs such as ‘DANGER, Construction Site. No Unauthorized Access’.

**Advertising signs**

Advertising: No advertising is permitted on the site other than the following:

- Approved project signs.
- Manufacturer’s name or names of owner on items of construction plant.
- Contractor’s mail box.

**Project work signs**

Requirement: Supply, install, maintain and remove all project work signs.

Certification: Before commencing the Works, check the digital design model provided for discrepancies between the digital design model and the drawings.

www.icsm.gov.au Supplied survey setting out information

**Road construction survey: To ICSM QA Specification G71 Road construction surveys.**

Certification: Before commencing the Works, check the digital design model provided for discrepancies between the digital design model and the drawings.
Provision of marks: The Superintendent will provide permanent marks as shown on the drawings and establish bench marks related to the level datum.

Transfer of marks: Transfer permanent survey marks clear of the operations before any of the given survey marks on the base lines or the various control lines are affected by the Works. This is a **WITNESS POINT**.

Relocation of survey control: Submit request for relocation of survey control, establishment of recovery pegs, or setting out or levelling. If no notice is provided and a control mark is disturbed or destroyed, then the cost of re-establishing the control is borne by the Contractor. This is a **HOLD POINT**.

Protection: Protect all supplied survey marks. The Contractor is responsible for any costs associated with re-establishing marks.

**Set out pegs**

Recovery pegs: Provide and fix adequate recovery pegs in suitable locations adjacent to the elements of work.

Removal: Unless otherwise directed, remove all pegs and profiles at practical completion.

**Survey equipment**

Requirement: Use electronic total stations and ancillary equipment for survey tasks in conformance with the following:

- Electromagnetic distance measuring device (EDM): Standard deviation for error < 5 mm + 5 ppm.
- Horizontal and vertical circles: Angular measurement standard deviation for error < 3 seconds of arc.
- One second of arc minimum count.
- Diometrical vertical circle reading and automatic tilt compensator.
- Capability to electronically record and store field data such as horizontal and vertical angles, distances, point notation, target and instrument heights.
- Calibration procedure and calibrated at all times.
- Calibrate immediately after any repairs.

**Laser and global positioning construction control systems**

Horizontal and longitudinal alignment control requirements:

- Offset pegs on one side of the road formation.
- Offset pegs 500 mm from the surface design edge of subgrade.
- Clearly mark chainages on the pegs.
- Spacing between pegs < 50 m on the straights and < 20 m on curves including all curve tangent points.
- Place pegs vertically.
- Tolerance: ± 25 mm to the exact horizontal location.
- Protect from disturbance. Submit procedure. This is a **HOLD POINT**.

Removal: Remove all pegs at practical completion.

### 3.7 SITE COMMUNICATIONS

**Site meetings**

Representation: Provide representation, including any Subcontractors that may be required to attend regular site meetings.

Meeting agenda: Include performance measures, coordination of program and work under the contract and resolution of any questions regarding the intent or interpretation of the documents.

*Meeting time:* [complete/delete]

Minutes: Site meetings will be chaired and minuted by the Superintendent. Copies of the minutes will be issued to all present at the meeting and others concerned with the matters discussed.

### 3.8 ENVIRONMENTAL PLANNING

**Protection of the environment**

*General:* [complete/delete]

*Environmental assessment and planning:* [complete/delete]

*Project specific environmental requirements:* [complete/delete]
Erosion and sedimentation control: To 1102 Control of erosion and sedimentation. Work outside working hours: Submit for approval any works required outside of normal working hours. Do not use any plant, machinery or equipment that would cause or is likely to cause a nuisance to the public.

Dust control: Minimise dust from disturbed areas. Submit dust control strategy before commencing excavation/earthworks operations. This is a HOLD POINT.

Removal of material: Dispose of material off-site to the requirements of the relevant Authorities.

Keep roads clean of soil: If required, keep roads clean of soil, provide the following:
- Wheel washes and rumble grids at all main road crossings.
- Sweep roads at least once a day where construction vehicles are travelling off the site.
- Cover all loads of soil being taken off site for disposal.

**Drainage of Works**

Stormwater control: To 1351 Stormwater drainage (Construction).

Stormwater diversion: Provide effectual diversion of surface water and proper flushing for storm and subsoil water across and beyond the works at all times. Do not interrupt the flow of stormwater and drainage along existing gutters and water tables.

Pumping: Keep trenches and excavations dewatered at all times during construction, including maintaining any pumping equipment.

Timing: Complete all permanent retention basins, and temporary erosion and sedimentation control measures before commencing earthworks.

**Blasting**

Blasting is not permitted: If required, submit for approval to conform with 1112 Earthworks (Roadways).

**Air quality**

Exhaust gases: Ensure there is no health risk or loss of amenity due to the emission of exhaust gases to the environment.

**Storage of fuels and chemicals**

Storage: Safely store all fuel and chemicals and conform to the following:
- Minimise fuels and chemicals stored on site.
- Install bunds and take other precautions to reduce the risk of spills.
- Implement a contingency plan to handle spills.

Toxic chemicals: Do not use herbicides and other toxic chemicals without written approval. This is a WITNESS POINT.

### 3.9 NOISE AND VIBRATION CONTROLS

**Limits on noise**

Working hours: Operational hours of plant, including the entry and/or departure of heavy vehicles, is restricted to 7 am to 6 pm Monday to Friday, 8 am to 1 pm on Saturdays and at no times on Sundays or Public Holidays. Work outside of the hours specified is not permitted without approval.

Maximum noise levels: Avoid excessive noise and long periods of elevated noise that is reasonably anticipated to annoy or adversely effect the adjacent community.

Sound pressure threshold: Less than L_{10} sound pressure level threshold, when measured at noise sensitive locations such as residential premises.

Assigned L_{10} sound pressure level threshold: [complete/delete]

www.environment.nsw.gov.au Noise suppression: Minimise noise nuisance including the following:
- Enclose noisy equipment.
- Provide noise attenuation screens.
- Maintain plant in good working order.
- Fit effective residential class silencers to all engine exhausts.
- Fit engine covers to all plant.

**Damage**

Responsibility for damage: Any damage and compensation payments resulting from non observance of the above requirements are the responsibility of the Contractor.
Limits on ground vibration
Levels: Make sure ground vibration levels transmitted from operating items of plant in the vicinity of residential premises do not exceed levels that are close to the lower level of human perception inside the premise or cause structural damage to the building.
Vibration limits: To AS 2670.1 and AS 2670.2.

Preferred and maximum weighted RMS values for continuous and impulsive vibration acceleration (m/s²) 1-80 Hz: [complete/delete]
Acceptable vibration dose values for intermittent vibration (m/s 1.75): [complete/delete]
Vibration assessment report: [complete/delete]

Responsibility for damage: Responsible for any damage and compensation payments as a result of non-observance of the above requirements, no claims will be considered by the Principal.

3.10 UTILITIES AND AUTHORITIES

Location
Drawings: The location of all existing utilities and services shown on the drawings are indicative only.
Verify: Before the commencing any excavation, ascertain and verify the location and depth of all Public Utility Mains and Consumer Services.
Contact: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia, of locating underground pipe and cables. See www.dialbeforeyoudig.com.au.
Notify: If there is any conflict between the actual location or elevation of any item and the location or elevation of any item shown on the drawings, notify the Superintendent. This is a WITNESS POINT.

Protection of services and utilities
Precautions: Secure and protect existing gas, water or drainage pipes, sewers, electric conduits or other existing works both underground and overhead.
OHS: Comply with statutory requirements for maintaining safe working clearance to overhead electrical services.
Repair to existing: Repair any damage caused to existing water, gas or drainage pipes, sewers, electric conduit or other existing works or services to the satisfaction of the Superintendent and the relevant Authority.
Costs: If repairs are not acceptable, the Superintendent may arrange repairs and charge the Contractor.
Notice to divert services: Give notice if it is required to remove, divert or cut into any existing sewer, drainage pipe, gas or water main, service pipes, electric conduits or other existing works.
Obtain direction for alterations to existing works. This is a WITNESS POINT.
Protection responsibility: The Contractor is responsible for the protection of any facilities and structures during the Contract period.

Liaison
Contractor responsibilities: Liaise with the service Authorities contractors as follows:
- Make appropriate allowances in the program for coordination with service Authorities.
- Make appropriate allowances in the program for the provision of installation by service Authorities during the works.
- Reinstatement, make good and backfill service trenches to the requirements of the service Authorities.
- Do not stop work due to operations by service Authorities without written notice.
- Do not interfere with the operations of service Authorities or their contractors on or near the site.
- Allow service Authorities to work on or near the site.

Limitations to work methods: Confirm, and include within work method procedures, any limitations with the relevant Authority, such as vibrations in the vicinity of underground and overhead facilities.

Relocation of services
Relocations of services by the Contractor: Arrange all relocations or alterations to the Relocation/alteration to services (by Contractor) schedule.
Timing of Contractor relocations of services: [complete/delete]
Relocations of services by the Principal: Relocations and expected program to Relocation/alteration to services (by Principal) schedule. Confirm relocation/alteration to services before commencement of works. This is a HOLD POINT.
Additional adjustments: If required by an Authority, provide additional adjustment to plant.
Maintenance responsibility: The Contractor is not responsible for the maintenance of any facilities installed or constructed by the various Authorities or structures and other facilities constructed by others (except where such structures and facilities form part of the Contract).
Utility relocation: Do not move utilities due to equipment or method of operation without approval from the relevant Authority.

Programming and duration of utility adjustments
Notice of date of completion: Give notice of the expected date of completion of each of the necessary parts of the Works required before each of the utility services listed in this worksection can be relocated. This is a WITNESS POINT.
Timing: Do not proceed with final trimming or subsequent parts of the work in any area of the work until the adjustment of all utilities within that area is complete.
Delays due to work by Authorities: If required, allow Authorities to remove, relocate, or work on their facilities before continuing the Works.

Allowance for utility adjustments: Program the following utility adjustments:

Extension of time: The Contractor is entitled to extensions of time if the utilities have not been relocated by these dates and this causes delay to the Contract. The Contractor has no right to monetary compensation or to any claim for damages because of any loss attributable to such delays.

3.11 SITE FACILITIES

General
Requirement: Provide and maintain temporary site facilities for personnel, including the office for the Superintendent, and the necessary temporary utility services. Remove or restore at practical completion.

Facilities required: Provide, equip and maintain temporary ablution facilities, dressing rooms, tool houses and other facilities required by any Industrial Ordinance, Award or Agreement for use of workers employed by the Contractor, or the Contractor’s sub-contractors. Remove them at practical completion.

Latrines: Provide temporary latrine accommodation for use of the workers, suitably enclosed and screened in conformance with the requirements of the Local Authority.
Sewer: Make a temporary connection to an existing sewer where one is available. Cap temporary sewer connection at practical completion.

Site facility design: Before erecting site facilities, submit a proposal for positioning of all units, services including septic or sewer, rubbish collection and storage areas for approval. Obtain approval from the local Authorities prior to submission. This is a HOLD POINT.

Office for Superintendent
Requirement: Provide, equip, maintain and remove at practical completion, an office, including toilet facilities, for the sole use of the Superintendent and staff. Conform with the following:

| Prefabricated building | - Minimum inside dimensions: 6 x 3 x 2.4 m high exclusive of toilet facilities.
|                        | - Weatherproof, adequately insulated and well ventilated.
|                        | - Provide two opening type windows fitted with insect-proof screens and an external door fitted with a cylinder night lock with two keys.
|                        | - Floor area: Approved vinyl flooring.
|                        | - Walls and ceiling: Painted to the approval of the Superintendent.
| Furniture and fittings | - One reference table of minimum size 1.5 x 0.9 m.
|                        | - One desk, with lockable drawers, of minimum size 1.5 x 0.9 m.
|                        | - Three office chairs and one stool all with padded seats, swivel base and adjustable height.
|                        | - Two 1.2 m² pin boards fixed to the walls.
|                        | - One 0.75 kW reverse cycle air conditioner.
Prefabricated toilet facilities

- Weatherproof and well ventilated, and connected to the temporary sewerage system.
- Minimum of one partitioned w.c. cubicle with door and latch.
- Separate wash area with minimum of one wash basin connected with hot and cold running water.
- Lockable external door with two keys.

Electricity

- Lighting to the office and toilet facilities.
- Two double power points to the office.

Telephone and data service

- Two telephone lines connected to the office with one line fitted with a telephone hand set.
- Provide a second line for a facsimile machine supplied by the Superintendent.
- Provide data telecommunication service connection to access emails and download drawings etc.

Charges: Pay all charges resulting from the supply, erection, installation, maintenance, cleaning and removal of the office, toilet facilities, electricity and telephone services.

Alternative site facilities: Submit proposal with full details for the use of alternative site facilities in existing buildings adjacent to, or in close proximity to, the Works.

**Water supply**

Temporary water supply: Provide temporary water supply for site facilities and for carrying out the Works.

Approvals: Obtain all approvals from the appropriate Authority for temporary water supply.

Removal: Remove on completion of the contract the temporary water supply service, except that to the Superintendent’s office.

**Electrical service**

Temporary electricity supply: Provide any temporary electricity supply required for site facilities and for carrying out the work under the contract.

Approvals: Obtain all approvals from the appropriate Authority for temporary electricity supply.

Removal: Remove on completion of the contract the temporary electricity supply service, reticulation and lighting except that to the Superintendent’s office.

**First aid**

Requirement: Provide, equip and maintain an adequate First Aid Treatment Centre on the site with an experienced First Aid person available at all times when work is in progress.

Signage and location: Clearly mark the First Aid facilities and make accessible to all personnel at all times.

Minimum provisions: To the current statutory requirements.

**Chain wire fence**

Fence: Provide a 1.83 m high galvanized chain wire mesh perimeter fence to 1195 Boundary fences for road reserves.

Gate: Provide a galvanized tubular steel vehicular access gate, for the temporary site facilities as documented or as directed.

Hessian covering: Cover the mesh fence with a suitable hessian or shadecloth screen for its full height.

Removal: Remove all galvanized fence, screen material and gate at practical completion.

**4 MEASUREMENT AND PAYMENT**

**4.1 MEASUREMENT**

**General**

Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 0136.1, 0136.2 and 0136.3.

**Methodology**

The following methodology will be applied for measurement and payment:
- No separate measurement and payment will be made for compliance with the requirements of this worksection except as specified in the pay item below.
- Deductions for nonconforming work: Where deductions for nonconforming work are given in the worksections, the nominated deductions will be applied to the rates given in the Pay Items for that item of work.

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>0136.1 Site Establishment</td>
<td>Lump sum</td>
<td>All costs associated with site establishment. To include all documented facilities, site security, fencing, signage, etc.</td>
</tr>
<tr>
<td>0136.2 Office for Superintendent</td>
<td>Lump sum</td>
<td>All costs associated with the provision of the documented facilities.</td>
</tr>
<tr>
<td>0136.3 Items from Superintendent</td>
<td>Each calculate for each type and quantity of each type of item/material.</td>
<td>All costs associated with receiving, storing and handling items to be supplied from Superintendent.</td>
</tr>
</tbody>
</table>

5 ANNEXURE A

5.1 ITEMS TO BE SUPPLIED BY PRINCIPAL

<table>
<thead>
<tr>
<th>Purpose in works</th>
<th>Material type</th>
<th>Location</th>
<th>Approx. quantity available</th>
<th>Cost as a rate excl GST</th>
<th>When available</th>
<th>Worksection clause</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

5.2 RELOCATION/ALTERATION TO SERVICES (BY CONTRACTOR)

<table>
<thead>
<tr>
<th>Type of utility or service</th>
<th>Owner</th>
<th>Location</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

5.3 RELOCATION/ALTERATION TO SERVICES (BY PRINCIPAL)

<table>
<thead>
<tr>
<th>Type of utility or service</th>
<th>Owner</th>
<th>Location</th>
<th>Requirement</th>
<th>Timing</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
### 5.4 CONTACTS

Contacts schedule

<table>
<thead>
<tr>
<th>Authority</th>
<th>Name</th>
<th>Position</th>
<th>Phone number</th>
<th>Fax number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water and sewerage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity</td>
<td></td>
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<tr>
<td>Gas</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Telephone</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Telstra</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optus</td>
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<td></td>
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</tr>
</tbody>
</table>
1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Establish, implement and maintain a quality management system (QMS) that provides confidence to the Principal of the following:
- The product specified can be produced.
- Critical processes are under control.
- Product performance has been confirmed.

Performance Requirements: [complete/delete]

Design
Designer: [complete/delete]
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
- Requirement: Conform to the following:
  - 0136 General requirements (Construction).
  - 0152 Schedule of rates – supply projects.

1.3 REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:

Standards
AS 1289 Methods of testing soils for engineering purposes
AS 1289.1.4.1-1998 Sampling and preparation of soils-Selection of sampling or test sites-Random number method
AS/NZS ISO 9000: 2006 Quality management systems-Fundamentals and vocabulary
AS/NZS ISO 9001: 2008 Quality management systems-Requirements
AS/NZS ISO 10005: 2006 Quality management systems-Guidelines for quality plans
AS ISO 10013: 2003 Guidelines for quality management system documentation
AS/NZS ISO 19011: 2003 Guidelines for quality and/or environmental management systems auditing

1.4 STANDARDS

General
Standard: To AS/NZS ISO 9001.

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- CAR: Corrective Action Request.
- ITP: Inspection and Test Plan.
- NNC: Notice of Nonconformance.
- QAR: Quality Assurance Representative (Principal).
- QMR: Quality Management Representative (Contractor).
- QMS: Quality Management System.
- WAE: Work-as-executed.
Definitions
For the purpose of this worksection, the definitions given in AS/NZS ISO 9000 and the following apply:

- **Certification**: A written assertion of facts.
- **Corrective action request**: A formal advice/instruction from the Superintendent requesting action to eliminate the cause of a detected nonconformity or other undesirable situation. Unless specifically noted, it will not require raising of an NCR.
- **Disposition**: Action taken to resolve nonconformance. (Lot Specific)
- **Hold Point**: A defined position during the Contract beyond which work can not proceed without mandatory verification and acceptance by the Superintendent. The issue of an NCR or a NNC automatically creates a Hold Point.
- **Inspection and test plan**: The working document which identifies the specific inspections and tests to be carried out for works required by the Contract.
- **Lot**: Any part of the works which has been constructed/manufactured under a continuous operation of uniform conditions and is essentially homogeneous with respect to material and general appearance. The whole of the work included in a lot of a uniform quality without obvious changes in attribute values.
- **Nonconformance report**: A mandatory (standard format) report submitted by the Contractor that details the nonconforming work and the Contractor’s proposed disposition of the nonconformance.
- **Notice of nonconformance**: Formal instruction from the Superintendent regarding product nonconformance from documented requirements. It automatically creates a Hold Point and requires an NCR from the Contractor.
- **Performance audit (Process audit, Technical procedure audit, Methods audit)**: An examination to evaluate whether established methods and procedures are being adhered to in practice.
- **Product**: The result of a set of interrelated or interacting activities which transforms inputs into outputs.
- **Product audit (Conformance audit, Service audit)**: An assessment of the conformity of the product with the specified technical requirements.
- **Qualified surveyor**: A surveyor who is eligible for membership of the Spatial Sciences Institute as a certified engineering surveyor.
- **Quality assurance representative (QAR)**: Appointed by the Principal for a specific project and responsible for the auditing, review and surveillance of procedures and documentation required by the Contractor's approved Quality Plan.
- **Quality check lists**: Forms completed during the manufacture/construction process verifying key steps, and records required for the quality register. Check lists apply to each identified lot of work.
- **Quality management representative (QMR)**: Also known as Project quality representative, appointed by the Contractor for a specific project with the authority and responsibility for the implementation and operation of the Quality Plan, to ensure that QMS requirements are not subordinated to design and productivity.
- **Quality register**: The files containing all quality control records such as test results, completed check lists, certificates of compliance, consignment dockets for materials procured.
- **Quality management system**: The organisational structure, responsibilities, procedures, processes and resources for implementing quality management.
- **Quality management system requirements**: The administrative activities affecting quality that need to be implemented and controlled to make sure that the product or a service meets documented quality requirements.
- **Special processes**: Those processes, the results of which cannot be directly examined to establish full conformance. Assurance of satisfactory conformance depends on evidence generated during the process.
- **System audit**: An examination of the documented quality management system represented by the quality manual, quality plan and quality register to evaluate their effectiveness in meeting the requirements of Australian Standards and the Contract documents.
- Validation: Confirmation, through the provision of objective evidence, that requirements for a specific intended use or application have been fulfilled.
- Witness point: A nominated position in the manufacture/construction stages of the Contract where the option of attendance may be exercised by the Superintendent, after notification of the requirement.
- Works: All labour, plant, equipment and materials required to complete a project in conformance with the Contract documents.

2 QUALITY MANAGEMENT SYSTEM

2.1 GENERAL REQUIREMENTS

Conformance
Work on and off-site: Conform to the QMS described within the Quality Plan including products and services for all works under the contract.
Contract documents: The QMS does not pre-empt, preclude or otherwise negate the requirements of any part of the contract documents.
Responsibility: QMS requirements do not relieve the Contractor of the responsibility to conform with the contract documents.
Subcontractors and Suppliers: Conform with this worksection and AS/NZS ISO 9001. This can be achieved by either of the following:
- Suppliers and Subcontractors operating their own QMS, linked to and coordinated under the Contractor's QMS.
- Suppliers and Subcontractors operating under the Contractor's QMS.

System requirements
QMS: Plan, develop and maintain a documented QMS conforming to this worksection, Annexure A and AS/NZS ISO 9001.
System purpose: To make sure of the following:
- The proposed work method is consistent with the specification requirements.
- ITPs and checklists are adequate and complete.
- Approved work methods are followed.
- The Superintendent adequately checks Hold and Witness Points.
Format: If the format of the QMS documents differ from the format of AS/NZS ISO 9001, provide a matrix outlining how the documented requirements are addressed by the QMS.

Management responsibility
Commitment: In the development a corporate QMS in conformance with AS/NZS ISO 9001 section 5, top management must perform the following:
- Focus on customer, statutory and regulatory requirements.
- Define authorities and responsibilities.
- Appoint QMR.
- Establish internal communication and review procedures.
- Make sure resources are available.

2.2 DOCUMENTATION REQUIREMENTS

General
QMS documentation requirements: Include the following:
- Quality policy and its objectives.
- Quality manual.
- Procedure documents.
- Work instructions.
- Forms.
- Quality plans.
- Specifications.
- Relevant external documents.
- Records.
Changes: Immediately implement changes to the project Quality Plan and QMS if the following occurs:
- Specification requirements are not adequately addressed.
- Nonconformity resulting from the Quality Plan or QMS.
- Audit initiates changes to the QMS.
- Practices have changed.
- Records: Provide copies of any quality records within 14 days of request.

AS/NZS ISO 9001: Keep a copy on site at all times.

Quality manual
Requirement: To AS/NZS ISO 9001 clause 4.2.2 and AS/NZS ISO 10013 clause 4.4. Include the following in the Quality Manual:
- Responsibility statements.
- Corporate policy.
- All applicable system requirement descriptions with reasons for those not regarded as applicable.
- Standard method statements.
- Standard ITPs.

Project Quality Plan
- Requirement: Provide and maintain a Quality Plan to AS/NZS ISO 9001 and AS/NZS ISO 10005. Provide the following:
  - Progressive documentation of new procedures as the work types become evident.
  - Planning and control systems: Describe critical processes and activities and provide verification for product control.
  - Coordination with the Contractor’s corporate Quality Manual.
  - Project specific quality system: Inform and direct personnel about the specific quality practices, resources, sequence of activities, controls and checks that must be implemented during the works.
  - Controlled conditions: Documentation to explain how each work process will be carried out.
  - Organisation structure: Include details of the specific responsibilities and authorities of the key personnel nominated for the management of the project.
  - QMR: Include the person’s qualifications, technical experience and present position, together with responsibilities and authorities to resolve quality matters.
  - Details of the personnel or contracted testing organisations who will be conducting each type of compliance inspection of testing of completed works, their experience, qualification and responsibilities.
  - Details of the person authorised to change construction processes on site.
  - ITPs to verify the works conform with the contract documents.
  - Purchasing quality requirements:
    - Critical characteristics of purchased products that affect the quality of the final product.
    - Method of communication with suppliers.
    - Methods used to evaluate, select and control suppliers.
    - The facilities and services that will be outsourced.
    - Material samples: The approved sample is the quality benchmark.
  - Purchasing quality verification: Conform to the following worksections:
    - 0162 Quality (Supply).
    - 0163 Quality (Delivery).

Additional system elements: [complete/delete]

Control of documents
Document control: Conform to AS/NZS ISO 9001 clauses 4.2.3 and 4.2.4 and AS/NZS ISO 10005 clauses 5.6 and 5.7.
Register: Maintain a register of each part of the Quality Plan. Register the number, date and recipient(s). Reissue to all registered when the Quality Plan is changed, superseded or recalled as required.

Requirement: Document within the Quality Plan the method of keeping quality registers, tracking and handling of NCR's, NNC's and site correspondence.

Quality register: Implement and maintain systematic records, indexed and filed so they are retrievable and accessible to the Superintendent or an appointed quality auditor within one working day of request.

Register of method statements: Provide a register listing all method statements (both standard and job specific) including the title, identifier and revision status.

Location: State in the quality plan where records are to be located.

WAE: Keep records of any amendments to design details for inclusion in WAE drawings.

Quality audit schedule: Include a quality audit schedule with the project quality plan in conformance with AS/NZS ISO 19011.

Audit reports: Provide copies to the Superintendent as requested.

2.3 RESOURCE MANAGEMENT

General
Conformance: Conform to AS/NZS ISO 9001 section 6 and AS/NZS ISO 10005 section 5.8.

Provision of resources: Determine and provide resources for the successful implementation of the project Quality Plan.

Limited availability: If a resource has limited availability, identify how demand from other projects/contracts will be satisfied.

Human resources: Provide personnel with the appropriate education, training, skills and experience for the project.

Infrastructure: Identify, provide and maintain the infrastructure required to achieve product conformity.

Work environment: Establish and manage the work environment to achieve product conformity.

2.4 PRODUCT REALISATION

Planning and design
Planning: Conform to AS/NZS ISO 9001. Determine the following:
- Quality objectives and requirements for the product.
- Processes and documents specific to the product.
- Required verification, validation, monitoring, measurement, inspection, test activities and the criteria for acceptance of the product.
- Records required as evidence that the realisation processes and resulting products conform.

Design: Design and/or verify the following, to conform with the Technical Specifications and AS/NZS ISO 9001:
- Temporary structures.
- Checking of permanent structures for construction loadings.
- Lifting devices for manufactured items.
- Alternative permanent structures or structural components proposed.
- Concrete mixes for structures and pavements and asphalt mixes for permanent works.
- Traffic control, temporary roadways and detours.
- Permanent works where design is nominated in the contract.

2.5 CONSTRUCTION AND SERVICE PROVISION

Control
Method statements: Detail the construction processes for all activities scheduled in Construction activities table.

Content: Include the following:
- Sequence of operations.
- Documented procedures and work instructions.
- Types of equipment required, capability, maintenance and calibration.
- Any special working environment requirements.
- Personnel competency and skills required,
- Criteria for workmanship and tolerances.
- Materials required.
- Safety requirements.
- Reference documents.
- Records produced.
- Planning.
- Verification measures.
- Inspection, test and control points.
- Monitoring of continuous suitability.
- Responsibility for implementing and monitoring work process controls and rectifying any deficiencies.

Check list: Provide a checklist, including the relevant inspection and test points, surveying control points, Hold Points, Witness Points and the officer responsible to verify each check point.
System audit: Audit each method statement whilst the process is in effect.

Absence of a method statement: If a method statement for a particular activity is required and there is none submitted, this will generate a Hold Point.

**Construction activities table**

<table>
<thead>
<tr>
<th>Worksection</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0257 Landscape – roadways and street trees</td>
<td>Landscaping</td>
</tr>
<tr>
<td>0292 Masonry walls</td>
<td>Construction of masonry walls</td>
</tr>
<tr>
<td>0293 Crib retaining walls</td>
<td>Construction of crib retaining walls</td>
</tr>
<tr>
<td>0319 Minor concrete works</td>
<td>Sprayed concrete</td>
</tr>
<tr>
<td>1111 Clearing and grubbing</td>
<td>Selective clearing and proposed equipment</td>
</tr>
<tr>
<td></td>
<td>Work near trees</td>
</tr>
<tr>
<td></td>
<td>Work within 4 m of tree</td>
</tr>
<tr>
<td>1112 Earthworks (Roadways)</td>
<td>Excavation procedures</td>
</tr>
<tr>
<td>1113 Stabilisation</td>
<td>Proposed curing method</td>
</tr>
<tr>
<td>1163 Rigid concrete and road safety barrier systems</td>
<td>Precast barriers</td>
</tr>
<tr>
<td></td>
<td>Installation</td>
</tr>
<tr>
<td>1341 Water supply - reticulation (Construction)</td>
<td>Protection of existing services</td>
</tr>
<tr>
<td></td>
<td>Cutting and disposal of existing asbestos pipe</td>
</tr>
<tr>
<td>1361 Sewerage systems – reticulation (Construction)</td>
<td>Protection of existing services</td>
</tr>
<tr>
<td>1392 Trenchless conduit installation</td>
<td>Trenchless conduit installation</td>
</tr>
<tr>
<td></td>
<td>Existing services</td>
</tr>
<tr>
<td>1433 Footpath and kerb ramp repairs</td>
<td>Safe work</td>
</tr>
</tbody>
</table>

**Lot identification**

Lots: Divide all items of work into lots as follows:
- Limits: Before sampling, choose lots within the limits given in the particular technical specification.
- Lot size: Not exceeding one day’s output for each work process being testing.
- Lot numbering: Allocate unique lot numbers compatible with the construction program. Use lot numbers to be identifiers on all QMS data.
- Field identification: Physically identify each lot, clearly identify lot boundaries. Maintain identification until the lot has achieved the specified quality.

Work on a lot: Do not commence work until the field identification is established.
Lot boundaries: When boundaries of a lot change, update the quality register.
Lot identification system: Make sure all site records and sample numbering systems allow easy identification of all test results and the materials incorporated in the works.
Traceability
General: Provide and maintain records of components for audit. Include the following traceability in the records:
- Concrete: Start the trace at the batch plant and finish at the location where the concrete is incorporated in the works.
- Asphalt: Start the trace at the batch plant and finish at the location where the asphalt is incorporated in the works.
- Stabilised material: Start trace at the batch plant and finish at the location where the material is incorporated in the works.
- Steel: Start the trace at the steelworks and finish at the location where the steel is incorporated in the works. Record the steel heat number, testing details and final location of installation.
- Batch details: Record all batch quantities, mix and dispatch time, testing details and location of placement.

Control of monitoring and measuring equipment
Equipment accuracy: Maintain inspection, testing and measuring equipment capable of producing the degree of accuracy specified in the referenced test methods.
Records: Demonstrate accuracy with regular records of calibration.

2.6 MEASUREMENT AND ANALYSIS
General
Testing: Conduct testing by a NATA registered laboratory accredited for those test methods and sampling procedures. Include the latest NATA advice of the terms of registration and current signatories within the quality plan.
Sampling: Conduct by personnel from the NATA registered laboratory which has been accredited for that sampling procedure and supervised by the approved signatory from that laboratory.
Test results: Report on NATA endorsed test documentation which includes a statement by the approved signatory certifying that the correct sampling procedures have been followed.

Special accreditation: [complete/delete]

Reinstatement: Reinstate all core holes, test holes, excavations and any other disturbance resulting from any testing activity to the standard within the Technical Specification.
Lots: All conformance inspections and tests are based on lots. In all cases the samples are considered representative of the lot and all test results are required to meet the appropriate tolerances for the lot.
Sampling locations: Propose sampling locations for approval prior to proceeding.
In-process and conformance inspections: Required for all works to confirm conformance. Performed by a responsible officer nominated in the Check List and certified by the Contractor's QMR

Frequency of testing
Minimum frequency of testing: Must be not less than that stated in the relevant worksection and as listed within the Sub-annexures of Annexure C.
Reduced frequency of testing: Submit proposal for approval with supporting statistical analysis verifying consistent conformance to the quality requirements.

Inspection and test plans
Document: Include within the quality plan all inspections, tests and documentation necessary to demonstrate that the works conform.
ITP: Establish and progressively maintain a system to demonstrate inspection and testing in conformance with AS/NZS ISO 9001 clause 8.2.4.
Minimum information for ITP (or ITP forms): Include the following:
- Person responsible for carrying out in-progress and final inspections or testing and at what stage of works these are to be carried out.
- Proposed inspection or test methods and recording of results.
- Acceptance criteria and frequency of inspection and testing.
- Specification tolerances.
- Person responsible for reviewing inspection and test results, evaluating whether work conforms, determining future action when work does not conform and closing out work lots.
- Measures to control nonconformity.
- When statistical analysis of test results is required.
- Person responsible for performing the final review of results to confirm that all inspections and tests have been carried out to verify complete conformity for each lot.
- Time limits for testing, submission, Hold Points and Witness Points that are nominated in the specifications.
- Identification of Hold Points or Witness Points.
- Check list for each lot.

**Test Register**
- Lot identification register: Include the following information:
  - Three dimensional surveyed location of the lot to include the chainage of the start and finish points, lateral location and layer location and/or the particular structure (eg. pier or abutment number, concrete placement number, etc).
  - Indication of conformance or nonconformance.
  - Summary of test results.
  - Location of test sites including test identification numbers.
  - For nonconforming lots, allocate a new number to the resubmitted/subdivided lot(s), ensure it also references the original lot number.

Inspection and test status: Show either on the ITP records or physically mark in the field the status of conformance for each lot.

**Random sampling**
Requirement: Use random sampling techniques for each lot for the control of compaction of each continuous layer of earthworks, flexible pavement and asphalt.
Test locations: Determine test locations for random sampling in conformance with AS 1289.1.4.1.
Location restrictions: Do not restrict sampling to locations dimensioned or otherwise defined for setting out the works in the drawings or specification.

### 2.7 MONITORING AND MEASUREMENT

**Hold points**
- Format: A summary of Hold Points are tabled in the **INSPECTIONS** clause of each worksection.
- Notice of inspection: Notify the Superintendent in advance of a Hold Point being reached.

Requirements for approval to proceed: In conformance with the following:
- Provide the information required by the technical specification.
- Certify that the particular lot/process is conforming.
- Certify that all underlying and adjacent lots affected by the lot in question are conforming.
- Submit the appropriate form (Check List, NCR or NNC) at least 24 hours prior to the time the Contractor wishes to proceed with the placement/construction of the next lot, unless some alternative arrangements have been agreed with the Superintendent.

Witness point: If the Hold Point has resulted from an NCR or NNC, the Superintendent’s approval may be conditional on a Witness Point being included. A summary of Witness Points on-site and off-site are tabled in the **INSPECTIONS** clause of each worksections.

### 2.8 SURVEYING CONTROL

**Requirements**
Survey control: A separate system requirement to include all measurement, calculation and recording procedures necessary to:
- Set out the works.
- Verify conformance with the drawings and specification in relation to dimensions, tolerances and three dimensional position.
- Determine lengths, areas or volumes of materials or products, where required for measurement of work.

Method Statement: Describe the control parameters for special processes which cannot be fully verified by inspection and testing. Address all potential errors that could be introduced by survey methods.
Surveyor qualifications: Appoint qualified surveyors to supervise and take responsibility for all surveying control.

Equipment: The procedures and equipment used must be capable of attaining the tolerances nominated in the specification.

Survey locations: Surveying for conformance verification purposes is not restricted to the locations used to set out the works.

Conformance verification surveys: Perform verification surveys as soon as practicable, but not later than one working day after the lot or component has become accessible for survey.

Control of documentation
Survey conformance report: Submit a survey conformance report for each lot or component where design levels, position and/or tolerances have been specified. Refer to the relevant worksection of the technical specification to establish if a Hold Point is generated before further works can commence.

Information required: Indicate the difference between actual and specified values for position and level (defined by co-ordinates or chainage and offset) and provide certification by the qualified surveyor responsible for the verification survey.

Survey records: Provide all survey records including equipment calibration records and nonconformity registers.

Field book pages: Include the following, clear labels, date and signature by the surveyor, cross indexed references to equipment used and lot/component identification. Survey conformance reports produced must reference the relevant field book page numbers.

Retain: Retain any automatically recorded data used for verification surveys, including a printout of both raw (field) data and reduced data.

Audit trail: Prepare procedures to describe the records system, to include, the method of storing and indexing of electronic records and the title of any computer software used for the reduction of survey measurements and calculations.

2.9 CONTROL OF NONCONFORMING WORKS

General
Detection and reporting: Report any works that depart from the documented requirements on a NCR form within two working days of detection, including the proposed disposition. A sample NCR form is included in Annexure B.

Extension of time: The deliberation on disposition of a nonconformance does not justify an extension of time to the contract period under any circumstances.

Proposed disposition: Include any of the following actions:
- Proposed additional works to bring the lot up to the specified standard.
- Proposed replacement of all or part of the lot to bring it up to the specified standard.
- A request to use the lot for a reduced level of service, if such a clause exists in the relevant worksection of the Technical Specification.
- For incidental defects, a request that the Superintendent accept the lot without alteration, as an exception with or without alteration to the respective unit rates.

Monitoring and measuring
NCR: Generates an automatic Hold Point until conformance has been achieved and the Superintendent has signed authorisation to proceed.

Progress: Do not cover any nonconforming works until a disposition has been accepted/approved and implemented.

Reworking: If the nonconformance can be overcome by reworking the lot with the original process, an NCR will not be required. However, maintain a record of the non-conformance to aid continual improvement.

Verification: Reworked/replaced lots to conform to the specified requirements.

Discrepancy: The Superintendent’s test results will prevail where there is any discrepancy in test results.

Control of documentation
CAR: Issued by the Superintendent for nonconformance to the Contractor’s quality system or methods. Unless specifically stated, this will not create a Hold Point.

NNC: Issued by the Superintendent for product nonconformance. This will immediately create a Hold Point and the Contractor is required to submit an NCR.

NCR form: Example form provided in Annexure B. If using alternative form it must include the following:
- Details of nonconformance.
- Proposed disposition.
- Provision for attachments.
- QAR comment/approval/rejection.
- Completion of disposition.
- Release of Hold Point.
- Corrective action to improve quality.
- Close out of NCR.

Authorised representative: All actions are to be signed off by authorised representatives of the Contractor and Superintendent as applicable (i.e. QAR and QMR).

Register: Implement and maintain a suitable numbering and registration system for all NCRs and NNCs, including cross referencing as required.

**Corrective action**

Requirement: Document procedure for corrective action to quality plan in conformance with AS/NZS ISO 9001 clause 8.5.2.

Proposed corrective action: Indicate on the NCR form the corrective action appropriate to ensure that the quality plan is effective in avoiding a recurrence of the nonconformance and continues to be effective.

### 2.10 COMPLETION

**Finalisation**

WAE: Submit WAE drawings for all works upon practical completion.

Register: Submit a copy of the quality register within one month of the date of practical completion. If requested, also provide a copy of all quality records.

Defects liability period: All quality related issues must be resolved and closed out before the end of the defects liability period.

**Maintenance**

Documents: Provide copies of all:
- Commissioning records.
- Operation manuals.
- Maintenance manuals.
- Product warranties.

**Review**

Requirement: Organise meeting(s) at end of contract to review the quality system and technical issues encountered on the project and the lessons to be learned for future projects. Review to focus on:
- The identification of nonconformances and the implementation of corrective action.
- Issues arising from inspections and audits.
- Specification issues.
- Design and technical issues.
- Safety issues.

Timing: Hold meeting(s) as close to practical completion as possible, before key personnel move on, so that they are still available to participate in review process.

Documentation: Determine procedures for end of contract review within quality plan.

### 3 MEASUREMENT AND PAYMENT

#### 3.1 MEASUREMENT

**General**

Payments made to the Schedule of Rates: To 0152 Schedule of rates – projects, this worksection, the drawings and Pay items 0161.1, 0161.2.

Unpriced items: If any item, for which a quantity of work is listed in the Schedule of Rates, is not priced, make due allowance in the prices of other items for the cost of the activity.
Methodology
The following methodology will be applied for measurement and payment:
- Progress payments for Pay item 0161.1 are calculated on the basis of 30% of the Lump Sum when the complete Quality Plan is available and the remainder on pro rata based on the monthly value of work done.
- Progress payments for Pay item 0161.2 are made pro rata on the monthly value of work done.
- Include any costs associated with preparing and conforming to the supply Quality Plan, see worksection 0162 Quality (Supply), in the unit price for product supply.
- Include any costs associated with preparing and conforming to the delivery Quality Plan, see worksection 0163 Quality (Delivery), in the unit price for product delivery.

3.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>0161.1 Quality system documents and records</td>
<td>Lump sum</td>
<td>All costs associated with the preparation and submission of the Quality Plan, the provision of the QMR on site and the maintenance of the quality records during the course of the Contract.</td>
</tr>
<tr>
<td>0161.2 Quality verification and control</td>
<td>Lump Sum</td>
<td>All costs for inspections, conformance surveys and testing required to verify that all aspects of the Works conform to the quality assurance provisions of the Contract.</td>
</tr>
</tbody>
</table>
4 ANNEXURES

4.1 ANNEXURE A - PROJECT QMS DOCUMENTATION FLOW CHART

- AS/NZS ISO 9001
- Specification for Contract Quality system
- Technical Specification
- 0147 Conditions of contract
- Quality Manual Annexures
- Method Statements
- Inspection and Test Plans
- Checklists
- Company Quality Manual Including SYSTEM REQUIREMENT DESCRIPTIONS
- Standard Method Statements
- Inspection and Test Plans
- Standard Checklists
- Job Specific Documents
- Selected Standard Corporate Documentation
- Quality Plan
4.2 ANNEXURE B – SAMPLE NONCONFORMANCE REPORT

NONCONFORMANCE REPORT

CONTRACT: ………………………………………………………………
PRODUCT OR SERVICE: …………………………………………
SUB-CONTRACTOR (if appropriate): ………………………
INSPECTION & TEST PLAN (ITP) No: ………………………

LOT No AND DESCRIPTION/LOCATION: ……………………………………………………………..

DETAILS OF NONCONFORMANCE: ………………………………………………………………

PROPOSED DISPOSITION: ……………………………………………………………………………

IS A SUPPLEMENTARY REPORT ATTACHED?: YES □ NO □

PRINCIPAL: APPROVED □ REJECTED □

COMMENT: …………………………………………………………………………………

PRINCIPAL SIGNATURE: ………………………………………..DATE: …………………

DISPOSITION COMPLETED
(Contractor) ………………………………………………………..DATE: …………………
<table>
<thead>
<tr>
<th>RELEASE OF HOLD POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Superintendent)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>DATE:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLOSE OUT OF NONCONFORMANCE REPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Contractor QMR)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>DATE:</td>
</tr>
</tbody>
</table>

4.3 ANNEXURE C - MAXIMUM LOT SIZES AND MINIMUM TEST FREQUENCIES

General
Lot sizes and test frequency: To the following Sub-annexures.
Contract requirements summary: To the Contract requirements summary table.
Certification: If material/product quality certification can be obtained from the supplier, documented tests need not be repeated.
Large projects: The Superintendent may relax the testing frequency after the Contractor has demonstrated consistent conformance to the quality requirements.

<table>
<thead>
<tr>
<th>Sub-annexure</th>
<th>Reference Worksection</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1 Earthworks (Roadways)</td>
<td>1112 Earthworks (Roadways)</td>
</tr>
<tr>
<td>C2 Water cycle management</td>
<td>1121 Open drains, including kerb and gutter</td>
</tr>
<tr>
<td></td>
<td>1122 Kerb and channel (gutter) replacement</td>
</tr>
<tr>
<td></td>
<td>1351 Stormwater drainage (Construction)</td>
</tr>
<tr>
<td></td>
<td>1352 Pipe drainage</td>
</tr>
<tr>
<td></td>
<td>1353 Precast box culverts</td>
</tr>
<tr>
<td></td>
<td>1354 Drainage structures</td>
</tr>
<tr>
<td>C3 Pavement moisture control</td>
<td>1171 Subsurface drainage</td>
</tr>
<tr>
<td></td>
<td>1172 Subsoil and foundation drains</td>
</tr>
<tr>
<td></td>
<td>1173 Pavement drains</td>
</tr>
<tr>
<td></td>
<td>1174 Drainage mats</td>
</tr>
<tr>
<td>C4 Stabilisation</td>
<td>1113 Stabilisation</td>
</tr>
<tr>
<td>C5 Flexible pavement base and subbase</td>
<td>1141 Flexible pavement base and subbase</td>
</tr>
<tr>
<td>C6 Bituminous cold mix</td>
<td>1142 Bituminous cold mix</td>
</tr>
<tr>
<td>C7 Sprayed bituminous surfacing</td>
<td>1143 Sprayed bituminous surfacing</td>
</tr>
<tr>
<td>C8 Asphalitic concrete</td>
<td>1144 Asphalitic concrete</td>
</tr>
<tr>
<td>C9 Placement rolled concrete subbase</td>
<td>1131 Rolled concrete subbase</td>
</tr>
<tr>
<td>C10 Placement of lean mix concrete subbase</td>
<td>1132 Lean mix concrete subbase</td>
</tr>
<tr>
<td>C11 Placement of plain and reinforced concrete base</td>
<td>1133 Plain and reinforced concrete base</td>
</tr>
<tr>
<td>C12 Placement of steel fibre reinforced concrete base</td>
<td>1134 Steel fibre reinforced concrete base</td>
</tr>
<tr>
<td>C13 Placement of continuously reinforced concrete base</td>
<td>1135 Continuously reinforced concrete base</td>
</tr>
<tr>
<td>C14 Ready mixed concrete production and supply</td>
<td>0319 Minor concrete works</td>
</tr>
<tr>
<td></td>
<td>1131 Rolled concrete subbase</td>
</tr>
<tr>
<td></td>
<td>1132 Lean mix concrete subbase</td>
</tr>
<tr>
<td></td>
<td>1133 Plain and reinforced concrete base</td>
</tr>
<tr>
<td></td>
<td>1134 Steel fibre reinforced concrete base</td>
</tr>
<tr>
<td></td>
<td>1135 Continuously reinforced concrete base</td>
</tr>
<tr>
<td>C15 Segmental paving</td>
<td>1145 Segmental paving</td>
</tr>
<tr>
<td>C16 Bituminous slurry surfacing</td>
<td>1146 Bituminous slurry surfacing</td>
</tr>
<tr>
<td>C17 Pavement markings</td>
<td>1191 Pavement markings</td>
</tr>
<tr>
<td>C18 Signposting</td>
<td>1192 Signposting</td>
</tr>
<tr>
<td>C19 Minor concrete works</td>
<td>0319 Minor concrete works</td>
</tr>
<tr>
<td>C20 Landscape – roadways and street trees</td>
<td>0257 Landscape – roadways and street trees</td>
</tr>
<tr>
<td>C21 Masonry walls</td>
<td>0292 Masonry walls</td>
</tr>
<tr>
<td>C22 Crib retaining walls</td>
<td>0293 Crib retaining walls</td>
</tr>
<tr>
<td>C23 Water supply - reticulation</td>
<td>1341 Water supply - reticulation (Construction)</td>
</tr>
<tr>
<td>C24 Sewerage systems - reticulation</td>
<td>1361 Sewerage systems - reticulation (Construction)</td>
</tr>
<tr>
<td>Sub-annexure C1 Earthworks (Roadways) (1112 Earthworks (Roadways))</td>
<td>Activity</td>
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<tr>
<td>Stripping topsoil</td>
<td>Surface levels</td>
</tr>
<tr>
<td>Excavation</td>
<td>Geometry</td>
</tr>
<tr>
<td>Floor of cuttings</td>
<td>Material quality: - CBR</td>
</tr>
<tr>
<td></td>
<td>Compaction</td>
</tr>
<tr>
<td>Blasting</td>
<td>Ground vibration/noise control</td>
</tr>
<tr>
<td>Foundation for Embankments</td>
<td>Compaction</td>
</tr>
<tr>
<td>Embankments - General</td>
<td>Geometry</td>
</tr>
<tr>
<td></td>
<td>Material quality: - CBR</td>
</tr>
<tr>
<td></td>
<td>Compaction/Moisture content</td>
</tr>
<tr>
<td>Embankments - Select zone</td>
<td>Geometry</td>
</tr>
<tr>
<td></td>
<td>Material quality: - Particle size distribution - CBR</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compaction/moisture content</td>
</tr>
<tr>
<td>Fill adjacent to bridges, wingwalls, retaining walls and culverts</td>
<td>Material quality: - Particle size distribution - Plasticity index</td>
</tr>
<tr>
<td></td>
<td>Compaction/moisture content</td>
</tr>
</tbody>
</table>

* Note: or part thereof, per lot.
### Sub-annexure C2 Water cycle management

(1351 Stormwater drainage, 1325 Pipe drainage, 1353 Precast box culverts, 1354 Drainage structures, 1121 Open drains including kerb and channel (gutter), 1122 Kerb and channel (gutter) replacement)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply of precast units</td>
<td>Precast quality: Suppliers documentary evidence and certification</td>
<td>1 batch</td>
<td>1 per type/size/class per batch</td>
<td></td>
</tr>
<tr>
<td>Siting and Excavation</td>
<td>Geometry</td>
<td>1 drainage line/structure</td>
<td>1 per drainage line/structure</td>
<td>Survey</td>
</tr>
<tr>
<td>Excavation by Blasting</td>
<td>Peak particle velocity</td>
<td>1 drainage line/structure</td>
<td>1 per drainage line/structure</td>
<td>Measure</td>
</tr>
<tr>
<td>Foundation</td>
<td>Compaction</td>
<td>1 drainage line/structure</td>
<td>1 per 20 lin m *</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>Material surrounding steel structures</td>
<td>Material quality: -pH/Electrical resistivity</td>
<td>1 drainage line/structure</td>
<td>1 per material</td>
<td>AS 1289.4.3.1 AS 1289.4.4.1</td>
</tr>
<tr>
<td>Bedding</td>
<td>Material quality: -Particle size distribution</td>
<td>1 contract</td>
<td>1 per 200 m³ *</td>
<td>AS 1141.11.1</td>
</tr>
<tr>
<td></td>
<td>Compaction/moisture content</td>
<td>1 drainage line/structure</td>
<td>1 per layer, per 20 lin m</td>
<td>AS 1289.5.4.1 AS 1289.5.7.1</td>
</tr>
<tr>
<td>Concrete bedding or lining</td>
<td>Geometry</td>
<td>1 Cross Section per 25 m</td>
<td>Survey and 3 m Straight Edge</td>
<td></td>
</tr>
<tr>
<td>Installation of precast units</td>
<td>Geometry</td>
<td>1 drainage line/structure</td>
<td>1 per drainage line/structure</td>
<td>Survey</td>
</tr>
<tr>
<td>Selected backfill</td>
<td>Material quality: -Maximum particle size -Plasticity index Compaction/moisture content</td>
<td>1 contract</td>
<td>1 per 100 m³ * AS 1289.3.3.1 AS 1289.5.4.1 AS 1289.5.7.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 contract</td>
<td>1 per 100 m³ *</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 drainage line/structure</td>
<td>1 per 2 layers per 50 m²</td>
<td></td>
</tr>
<tr>
<td>Rock fill for gabions/ wire mattresses</td>
<td>Material quality: -Wet strength -Wet/dry strength variation</td>
<td>1 contract</td>
<td>1 per contract AS 1141.22</td>
<td></td>
</tr>
<tr>
<td>Kerb and gutter</td>
<td>Geometry</td>
<td>1 contract</td>
<td>1 Cross section per 25 m</td>
<td>Survey and 3 m straight edge</td>
</tr>
</tbody>
</table>

* Note: or part thereof, per lot

### Sub-annexure C3 Pavement Moisture Control

(1171 Subsurface drainage, 1172 Subsoil and foundation drains, 1173 Pavement drains, 1174 Drainage mats)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material supply</td>
<td>Material quality—Supplier’s documentary evidence and certification of: Pipe</td>
<td>1 contract/size</td>
<td>1 per type/size</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Filter material: -Grading (Type A, B, C, D)</td>
<td>1 contract/size</td>
<td>1 per type</td>
<td>AS 1141.11.1</td>
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</table>
### Key quality verification requirements

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Coefficient of permeability</td>
<td>- Type B</td>
<td>1 contract/size</td>
<td>1 per type</td>
<td>AS 1289.5.1.1, ASTM-D2434-68</td>
</tr>
<tr>
<td>- Grading variation after</td>
<td>- Treatment Type B</td>
<td>1 contract/size</td>
<td>1 per type</td>
<td>AS 1141.11.1</td>
</tr>
<tr>
<td>- Wet Strength (Type C, D)</td>
<td></td>
<td>1 contract/size</td>
<td>1 per type</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td>- 10% Fines Wet/Dry (Type C, D)</td>
<td></td>
<td>1 contract/size</td>
<td>1 per type</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td>Geotextile</td>
<td></td>
<td>1 contract</td>
<td>1 per type</td>
<td></td>
</tr>
<tr>
<td>Excavation – Trench base</td>
<td>Line and Grade</td>
<td>1 drainage line</td>
<td>1 per 200 lin m</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Compaction</td>
<td>1 drainage line</td>
<td>1 per 200 lin m*</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>Bedding and backfill:</td>
<td>Compaction</td>
<td>1 drainage line</td>
<td>1 per drainage line</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>- Filter material</td>
<td></td>
<td>1 drainage line</td>
<td>1 per 200 lin m*</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td></td>
<td>Compaction</td>
<td>1 drainage line</td>
<td>1 per 200 lin m*</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>- Earth backfill</td>
<td>Compaction</td>
<td>1 drainage line</td>
<td>1 per 200 lin m*</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>Drainage mat</td>
<td>Geometry</td>
<td>2000m²</td>
<td>1 Cross Section per 25 m</td>
<td>Survey</td>
</tr>
<tr>
<td>* Note: or part thereof, per lot</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Sub-annexure C4 Stabilisation

**Material supply**

- Cement
  - 1 contract
  - 1 per 100t
  - AS 3972 and AS 2350 (various)

- Quicklime
  - Available lime (CaO content)
    - 1 contract
    - 1 per 100t
    - AS 3583.12
  - Slaking rate
    - 1 contract
    - 1 per 100t
    - T432
  - Particle size Dist'n
    - 1 contract
    - 1 per contract
    - AS 1141.11.1

- Hydrated lime
  - Available Lime (CaOH2)
    - 1 contract
    - 1 per 100t
    - AS 3583.12
  - Residue on sieving
    - 1 contract
    - 1 per contract
    - AS 3583.14

- Ground blast furnace slag
  - 1 contract
  - 1 per month
  - AS 3583.2 and AS 3582.2

- Flyash
  - 1 contract
  - 1 per month
  - AS 3583.1 and AS 3582.1

- Blended stabilising agent
  - 1 contract
  - 1 per month
  - AS 2350.4

- Water
  - Chloride ion content
    - 1 contract
    - 1 per contract
    - AS 3583.13

  - Sulphate ion content
    - 1 contract
    - 1 per contract
    - AS 1289.4.2.1
### 0161 Quality (Construction)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix design</td>
<td>NATA certification— Supplier's documentary evidence and certification</td>
<td>1 mix</td>
<td>1 per mix</td>
<td></td>
</tr>
<tr>
<td>Stationary mixing plant</td>
<td>Application rate of stabilising agent</td>
<td>1 day's production</td>
<td>1 per 100t</td>
<td></td>
</tr>
<tr>
<td>In-situ spreading</td>
<td>Compressive strength of product</td>
<td>1 day's production</td>
<td>1 per 100t</td>
<td>AS 1289.6.1.1</td>
</tr>
<tr>
<td>Trimming and compaction</td>
<td>Geometry</td>
<td>1 layer 2,000 m², max 1 day's placement</td>
<td>One cross section per 25 m</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Surface quality</td>
<td>1 layer 2,000 m², max 1 day's placement</td>
<td>10 per 200 m lane length *</td>
<td>3 m straight edge</td>
</tr>
<tr>
<td></td>
<td>Average layer thickness</td>
<td>1 layer 2,000 m², max 1 day's placement</td>
<td>1 per lot</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Average width</td>
<td>1 layer 2,000 m², max 1 day's placement</td>
<td>1 per lot</td>
<td>Measure/survey</td>
</tr>
<tr>
<td></td>
<td>Relative compaction/moisture content</td>
<td>1 layer 2,000 m², max 1 day's placement</td>
<td>3 per lot</td>
<td>AS 1289.5.7.1 AS 1289.5.8.1</td>
</tr>
</tbody>
</table>

* Note: or part thereof, per lot.

### Sub-annexure C5 Flexible pavement base and subbase

*(1141 Flexible pavement base and subbase)*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
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<tbody>
<tr>
<td>Base and subbase supply</td>
<td>Material quality— Supplier's documentary evidence and certification</td>
<td>1 Contract</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Particle size distribution</td>
<td>1 per 1,000t</td>
<td>AS 1289.3.6.1</td>
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<tr>
<td></td>
<td>- Liquid Limit</td>
<td>1 per 1,000t</td>
<td>AS 1289.3.1.1</td>
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<tr>
<td></td>
<td>- Plasticity Index</td>
<td>1 per 1,000t</td>
<td>AS 1289.3.3.1</td>
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<tr>
<td></td>
<td>- Linear shrinkage</td>
<td>1 per 1,000t</td>
<td>AS 1289.3.4.1</td>
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<tr>
<td></td>
<td>- Maximum dry compressive strength</td>
<td>1 per 5,000t</td>
<td>AS 1141.52</td>
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<tr>
<td></td>
<td>- Particle shape</td>
<td>1 per 1,000t</td>
<td>AS 1141.14</td>
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<tr>
<td></td>
<td>- Aggregate wet strength</td>
<td>1 per 5,000t</td>
<td>AS 1141.22</td>
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<td></td>
<td>- Wet/Dry strength variation</td>
<td>1 per 5,000t</td>
<td>AS 1141.22</td>
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<td></td>
<td>- Los Angeles value</td>
<td>1 per 1,000t</td>
<td>AS 1141.23</td>
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<td>- CBR</td>
<td>1 per 5,000t</td>
<td>AS 1289.6.1.1</td>
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<td></td>
<td>- Modified Texas Triaxial</td>
<td>1 per contract</td>
<td>T171</td>
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<td>Activity</td>
<td>Key quality verification requirements</td>
<td>Maximum lot size</td>
<td>Minimum test frequency</td>
<td>Test method</td>
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<td></td>
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<tr>
<td></td>
<td>- Unconfined compressive strength</td>
<td>1 per 5,000t</td>
<td>AS 5101.4</td>
<td></td>
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<tr>
<td></td>
<td>- Unconfined compressive strength (Bound)</td>
<td>1 Contract</td>
<td>AS 5101.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geometry: Alignment &amp; level</td>
<td>One layer 2,000 m² or max 1 day's placement</td>
<td>1 Cross Section per 15 m</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>- Width and Surface Trim</td>
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<td>10 per 5,000 m² layer or 3 per lot if less</td>
<td>Measure &amp; 3 m Straight Edge</td>
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<tr>
<td></td>
<td>Compaction/moisture content / dry density testing</td>
<td>One layer 5,000 m² or max 1 day's placement</td>
<td>10 per 5,000 m² layer or 3 per lot if less</td>
<td>T130 AS 1289.5.2.1 AS 1289.5.3.2A S 1289.5.4.1 AS 1289.5.8.1</td>
</tr>
<tr>
<td>Placement</td>
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</table>

Sub-annexure C6 Bituminous cold mix
(*1142 Bituminous cold mix*)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials supply</td>
<td>Material Quality—Supplier's documentary evidence and certification of:</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Coarse aggregates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grading</td>
<td>1 contract or 1 mth's prod'n</td>
<td>1 per month 1 per contract or change in material</td>
<td>AS 2758.5 AS 1141.11.1 AS 1141.22 AS 1141.15 AS 1141.18</td>
</tr>
<tr>
<td></td>
<td>Wet strength</td>
<td>1 contract &quot; &quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wet/dry strength</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flakiness index</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Fractured faces</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Fine aggregates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grading</td>
<td>1 contract or 1 mth's prod'n</td>
<td>1 per month</td>
<td>AS 1141.11.1</td>
</tr>
<tr>
<td></td>
<td>- Mineral filler</td>
<td></td>
<td>1 per month</td>
<td>AS 2150</td>
</tr>
<tr>
<td></td>
<td>- Class 170 or 320 bitumen binder</td>
<td></td>
<td>1 per month</td>
<td>AS 2008</td>
</tr>
<tr>
<td></td>
<td>Cutback bitumen</td>
<td></td>
<td>1 delivery/ tanker</td>
<td>AS 2157</td>
</tr>
<tr>
<td></td>
<td>Flux Oil and Cutter Oil</td>
<td></td>
<td>1 delivery/ tanker</td>
<td>AS 3568</td>
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<tr>
<td>Mix design</td>
<td>Approval of mix and NATA documentation. Supplier's documentary evidence and certification.</td>
<td></td>
<td>1 mix per contract (less than 12 months old)</td>
<td>Approval</td>
</tr>
<tr>
<td>Production mix</td>
<td>Grading</td>
<td>Each production lot</td>
<td>1 per contract or</td>
<td>AS 1141.11.1</td>
</tr>
</tbody>
</table>

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### Sub-annexure C7 Sprayed bituminous surfacing

#### (1143 Sprayed bituminous surfacing)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials supply</td>
<td>Material Quality - Suppliers documentary evidence and certification of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Class 170 bitumen</td>
<td>1 tanker load</td>
<td>1 per tanker load</td>
<td>AS 2008</td>
</tr>
<tr>
<td></td>
<td>- Refinery cutback bitumen</td>
<td>1 tanker load</td>
<td>1 per tanker load</td>
<td>AS 2157</td>
</tr>
<tr>
<td></td>
<td>- Polymer modified binder</td>
<td>1 tanker load</td>
<td>1 per tanker load</td>
<td>AS 2341.21</td>
</tr>
<tr>
<td></td>
<td>- Bitumen Adhesion agent</td>
<td>1 delivery</td>
<td>1 per delivery</td>
<td>AS 3568</td>
</tr>
<tr>
<td></td>
<td>- Cutback oils</td>
<td>1 delivery/tanker</td>
<td>1 per delivery/tanker</td>
<td>AS 2758.2</td>
</tr>
<tr>
<td></td>
<td>- Aggregate precoating agent</td>
<td>1 delivery/tanker</td>
<td>1 per delivery/tanker</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Aggregate</td>
<td>1 contract</td>
<td>1 per 400 m³</td>
<td></td>
</tr>
</tbody>
</table>

| Application rates       | Binder                                                                                                  | 1 day’s operation         | Calculate per spray run|                    |
|                        | Aggregate                                                                                                | 1 day’s operation         | Calculate per spray run|                    |

* Note: or part thereof, per lot

### Sub-Annexure C8 Asphaltic concrete

#### (1144 Asphaltic concrete (Roadways))

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials supply</td>
<td>Material quality—Supplier's documentary evidence and certification of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Coarse and fine aggregates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grading</td>
<td>1 wk’s prod’n</td>
<td>1 per day</td>
<td>AS 2758.5</td>
</tr>
<tr>
<td></td>
<td>Moisture content</td>
<td>1 wk’s prod’n</td>
<td>1 per day</td>
<td>AS 2892.1.1</td>
</tr>
<tr>
<td></td>
<td>Wet strength</td>
<td>1 contract</td>
<td>1 per</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td></td>
<td>Wet/dry strength variation</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td></td>
<td>Particle shape</td>
<td>1 contract</td>
<td>or change in material</td>
<td>AS 1141.14</td>
</tr>
<tr>
<td></td>
<td>Fractured faces</td>
<td>1 contract</td>
<td></td>
<td>AS 1141.18</td>
</tr>
<tr>
<td></td>
<td>Polishing agg friction value</td>
<td>1 contract</td>
<td></td>
<td>AS 1141.42</td>
</tr>
<tr>
<td></td>
<td>- Mineral filler</td>
<td>1 contract or 1 month’s production</td>
<td>contract or 1 per month’s production</td>
<td>AS 2150</td>
</tr>
<tr>
<td></td>
<td>- Bitumen binder</td>
<td>1 refinery</td>
<td>1 per tanker load</td>
<td>AS 2008</td>
</tr>
<tr>
<td>Activity</td>
<td>Key quality verification requirements</td>
<td>Maximum lot size</td>
<td>Minimum test frequency</td>
<td>Test method</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>batching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Polymer modified bitumen</td>
<td>Elasticity recovery at 60°C Viscosity on ER at 60°C Torsional recovery at 25°C Viscosity at 180°C</td>
<td>1 production batch by supplier</td>
<td>1 per tanker load</td>
<td>AG:PT/T121 AG:PT/T121 AG:PT/T122 AG:PT/T111</td>
</tr>
<tr>
<td>-Bitumen adhesion agent</td>
<td>Resistance to stripping</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>T230 or nominated equivalent</td>
</tr>
<tr>
<td>-Reclaimed asphalt pavement (RAP)</td>
<td></td>
<td>1 stockpile</td>
<td>1 per stockpile</td>
<td>AS 1141.11.1</td>
</tr>
<tr>
<td>-Bitumen emulsion</td>
<td></td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 1160</td>
</tr>
<tr>
<td>Mix design – Nominated mix</td>
<td>Approval of mix and NATA certification. Supplier's documentary evidence and certification</td>
<td>1 mix per contract</td>
<td>1 per mix</td>
<td></td>
</tr>
<tr>
<td>Production mix</td>
<td>Temperature</td>
<td></td>
<td>1 per truck load</td>
<td>Measure</td>
</tr>
<tr>
<td></td>
<td>Moisture content Grading Binder content</td>
<td>1144 7 from Spec 1144 Asphaltic concrete as included as separate table below. Additionally, max lot size one 12 hr shift’s production.</td>
<td></td>
<td>AS/NZS 2891. 10 AS/NZS 2891. 3.3 AS/NZS 2891. 3.1</td>
</tr>
<tr>
<td>Resistance to stripping</td>
<td>1 production mix</td>
<td>1 per mix per 5000 t or once per month (whichever is the most frequent)</td>
<td></td>
<td>T640</td>
</tr>
<tr>
<td>Laying and compaction</td>
<td>Temperature</td>
<td>1 day’s laying per site</td>
<td>1 per truck load</td>
<td>Measure</td>
</tr>
<tr>
<td></td>
<td>Levels</td>
<td>1 day’s laying per site</td>
<td>1 cross section per 25 m</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Shape</td>
<td>1 day’s laying</td>
<td>10 per 200 m* lane length</td>
<td>3 m Straight Edge</td>
</tr>
<tr>
<td></td>
<td>Relative compaction/layer thickness</td>
<td>1 day’s laying</td>
<td>6 cores per lot or 10 nuclear density tests per lot</td>
<td>AS 2891.9.3 or Nuclear Density Meter</td>
</tr>
</tbody>
</table>

* Note: or part thereof, per lot.

**Minimum Testing Frequencies For Asphalt Production**

<table>
<thead>
<tr>
<th>Quantity of asphalt in production lot</th>
<th>Minimum frequency of testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100 tonnes</td>
<td>One per 50 tonnes or part thereof</td>
</tr>
<tr>
<td>101 to 300 tonnes</td>
<td>One per 100 tonnes or part thereof</td>
</tr>
<tr>
<td>301 to 600 tonnes</td>
<td>One per 150 tonnes or part thereof</td>
</tr>
<tr>
<td>Over 600 tonnes</td>
<td>One per 200 tonnes or part thereof</td>
</tr>
</tbody>
</table>
### Sub-annexure C9 Placement of rolled concrete subbase

**1131 Rolled concrete subbase**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete supply</td>
<td>Refer Sub-Annexure C14:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ready-mixed concrete production and supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flyash</td>
<td>Contract</td>
<td>1 per contract</td>
<td>AS 3582.1</td>
<td></td>
</tr>
<tr>
<td>Consistency (Index of compactibility)</td>
<td>1 day’s production</td>
<td>1 per day’s production per mix type</td>
<td>AS 1012.3.4</td>
<td></td>
</tr>
<tr>
<td>Drying shrinkage</td>
<td>Contract</td>
<td>1 per contract per mix design</td>
<td>AS 1012.13</td>
<td></td>
</tr>
<tr>
<td>Compressive strength of mix designs</td>
<td>Contract</td>
<td>3 per contract per mix design</td>
<td>AS 1012.9</td>
<td></td>
</tr>
<tr>
<td>Placement</td>
<td>Compressive strength (7 day and/or 28 day)</td>
<td>1 layer 2000 m² or 1 day’s production</td>
<td>AS 1012.8.1</td>
<td></td>
</tr>
<tr>
<td>Field density</td>
<td>1 layer 2000 m² or 1 day’s production</td>
<td>3 per 1000 m² layer or 3 per lot if less</td>
<td>AS 1289.5.8.1</td>
<td></td>
</tr>
<tr>
<td>Thickness and surface level</td>
<td>1 layer 2000 m² or 1 day’s production</td>
<td>10 stations per 1000 m² or minimum of 4 for smaller lots</td>
<td>Survey</td>
<td></td>
</tr>
<tr>
<td>Profile factor (straight edge tolerance)</td>
<td>1 layer 2000 m² or 1 day’s production</td>
<td>10 stations per 1000 m² or minimum of 4 for smaller lots</td>
<td>3 m straight edge</td>
<td></td>
</tr>
</tbody>
</table>

### Sub-annexure C10 Placement of lean mix concrete subbase

**1132 Lean mix concrete subbase**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete supply</td>
<td>Refer Sub-Annexure C14:</td>
<td>50 m³</td>
<td>1 per 50 m³</td>
<td>Measure</td>
</tr>
<tr>
<td></td>
<td>Ready-mixed concrete production and supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete/air temperature</td>
<td>50 m³</td>
<td>1 per 50 m³</td>
<td>AS 1012.4.2</td>
<td></td>
</tr>
<tr>
<td>Air content</td>
<td>50 m³</td>
<td>1 per 50 m³</td>
<td>AS 1012.3.1</td>
<td></td>
</tr>
<tr>
<td>Consistency—Slump</td>
<td>50 m³</td>
<td>1 pair per 50 m³</td>
<td>AS 1012.1, AS 1012.8.1, AS 1012.9</td>
<td></td>
</tr>
<tr>
<td>Compressive strength (7 day)</td>
<td>50 m³</td>
<td>1 pair per 50 m³</td>
<td>AS 1012.1, AS 1012.8.1, AS 1012.9</td>
<td></td>
</tr>
<tr>
<td>Compressive strength (28 day)</td>
<td>50 m³</td>
<td>1 pair per 50 m³</td>
<td>AS 1012.1, AS 1012.8.1, AS 1012.9</td>
<td></td>
</tr>
<tr>
<td>Placement</td>
<td>Thickness</td>
<td>50 m³</td>
<td>5 m grid on plan area</td>
<td>Survey and check with subgrade survey</td>
</tr>
<tr>
<td></td>
<td>Geometry</td>
<td>50 m³</td>
<td>1 cross section per 15 m</td>
<td>Survey 3 m straight edge</td>
</tr>
<tr>
<td>Activity</td>
<td>Key quality verification requirements</td>
<td>Maximum lot size</td>
<td>Minimum test frequency</td>
<td>Test method</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Curing</td>
<td>Material quality—Supplier's documentary evidence and certification</td>
<td>1 contract</td>
<td>1 per production batch</td>
<td>AS 3799</td>
</tr>
<tr>
<td></td>
<td>Application rate</td>
<td>1 day's work</td>
<td>1 per 1000 m²</td>
<td>AS 1160</td>
</tr>
<tr>
<td>Joints</td>
<td>Geometry</td>
<td>50 m³</td>
<td>All joints</td>
<td>Survey</td>
</tr>
</tbody>
</table>

**Sub-annexure C11 Placement of plain and reinforced concrete base**

*(1133 Plain and reinforced concrete base)*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete supply</td>
<td>Refer Sub-Annexure C14: Ready-Mixed Concrete Production and Supply</td>
<td>50 m³</td>
<td>1 per 50 m³</td>
<td>Measure</td>
</tr>
<tr>
<td></td>
<td>Concrete/Air Temperature</td>
<td>50 m³</td>
<td>1 per 50 m³</td>
<td>AS 1012.4.2 Method 2</td>
</tr>
<tr>
<td></td>
<td>Air Content</td>
<td>50 m³</td>
<td>1 per 50 m³</td>
<td>AS 1012.3.1</td>
</tr>
<tr>
<td></td>
<td>Consistency - Slump</td>
<td>50 m³</td>
<td>1 per load</td>
<td>AS 1012.1</td>
</tr>
<tr>
<td></td>
<td>Compressive Strength (7 day)</td>
<td>50 m³</td>
<td>1 pair per 50 m³</td>
<td>AS 1012.8.1</td>
</tr>
<tr>
<td></td>
<td>Compressive Strength (28 day)</td>
<td>50 m³</td>
<td>1 pair per 50 m³</td>
<td>AS 1012.9</td>
</tr>
<tr>
<td>Placement</td>
<td>Relative Compaction</td>
<td>50 m³</td>
<td>1 per 50 m³²</td>
<td>AS 1012.14</td>
</tr>
<tr>
<td></td>
<td>-Machine placed</td>
<td>Area between 2 consecutive const. joints or 50 m³ (whichever is the lesser)</td>
<td>2 per lot</td>
<td>AS 1012.14</td>
</tr>
<tr>
<td></td>
<td>-Hand placed</td>
<td>50 m³</td>
<td>1 per 50 m³³</td>
<td>AS 1012.14</td>
</tr>
<tr>
<td></td>
<td>Thickness</td>
<td>50 m³</td>
<td>5 m grid on plan area</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Geometry</td>
<td>50 m³</td>
<td>1 cross section per 15 m</td>
<td>Survey and 3 m straight edge</td>
</tr>
<tr>
<td>Ride Quality</td>
<td>Profile factor</td>
<td>1000 m²</td>
<td>10/lane/lot</td>
<td>3 m straight edge</td>
</tr>
<tr>
<td>Surface Texture</td>
<td>Texture depth</td>
<td>1000 m²</td>
<td>2 per lot</td>
<td>Survey</td>
</tr>
<tr>
<td>Curing</td>
<td>Material quality - supplier's documentary evidence and certification</td>
<td>1 contract</td>
<td>1 per production batch</td>
<td>AS 3799</td>
</tr>
<tr>
<td></td>
<td>Application rate</td>
<td>1 day's work</td>
<td>1 per 1000 m²</td>
<td>AS 1160</td>
</tr>
<tr>
<td>Joints</td>
<td>Sealant material quality - supplier's documentary evidence and certification</td>
<td>1 contract</td>
<td>1 per prod'n batch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Geometry</td>
<td>50 m³</td>
<td>All joints</td>
<td>Survey</td>
</tr>
</tbody>
</table>

* Note: or part thereof, per lot.

**Sub-annexure C12 Placement of steel fibre reinforced concrete base**

*(1134 Steel fibre reinforced concrete base)*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
</table>

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<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concrete supply</td>
<td>Refer Sub-Annexure C14: Ready-mixed concrete production and supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete/air temperature</td>
<td>A production lot</td>
<td>As required by Superintendent</td>
<td>Measure</td>
<td></td>
</tr>
<tr>
<td>Air content</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1012.4.2 Method 2</td>
<td></td>
</tr>
<tr>
<td>Consistency—Slump</td>
<td>50 m³</td>
<td>1 per load</td>
<td>AS 1012.3.1</td>
<td></td>
</tr>
<tr>
<td>Compressive strength (7 day)</td>
<td>50 m³</td>
<td>1 pair per 50 m³</td>
<td>AS 1012.1 AS 1012.8.1 AS 1012.9</td>
<td></td>
</tr>
<tr>
<td>Compressive strength (28 day)</td>
<td>50 m³</td>
<td>1 pair per 50 m³</td>
<td>AS 1012.1 AS 1012.8.1 AS 1012.9</td>
<td></td>
</tr>
<tr>
<td>Drying shrinkage</td>
<td>1 day’s production or 150 m³ (whichever is the lesser)</td>
<td>3 per lot</td>
<td>AS 1012.13</td>
<td></td>
</tr>
<tr>
<td>Placement</td>
<td>Relative compaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Machine placed</td>
<td>50 m³</td>
<td>1 per 50 m³</td>
<td>AS 1012.14</td>
<td></td>
</tr>
<tr>
<td>-Hand placed</td>
<td>Area between 2 consecutive const. joints</td>
<td>2 per lot</td>
<td>AS 1012.14</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>50 m³</td>
<td>5 m grid on plan area</td>
<td>Survey</td>
<td></td>
</tr>
<tr>
<td>Geometry</td>
<td>50 m³</td>
<td>1 cross section per 15 m</td>
<td>Survey 3 m straight edge</td>
<td></td>
</tr>
<tr>
<td>Ride Quality</td>
<td>Profile factor</td>
<td>50 m³</td>
<td>All lanes</td>
<td>3 m str. edge</td>
</tr>
<tr>
<td>Surface Texture</td>
<td>Texture depth</td>
<td>50 m³</td>
<td>2 per 50 m³</td>
<td>Survey</td>
</tr>
<tr>
<td>Curing</td>
<td>Material quality—Supplier's documentary evidence and certification</td>
<td>1 contract</td>
<td>1 per production batch</td>
<td>AS 3799 AS 1160</td>
</tr>
<tr>
<td>Application Rate</td>
<td>1 day's work</td>
<td>1 per 1000 m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joints</td>
<td>Material quality—Sealant supplier's documentary evidence and certification</td>
<td>1 contract</td>
<td>1 per production batch</td>
<td></td>
</tr>
<tr>
<td>Geometry</td>
<td>50 m³</td>
<td>All joints</td>
<td>Survey and 3 m straight edge</td>
<td></td>
</tr>
<tr>
<td>Steel supply</td>
<td>Material quality—Supplier's documentary evidence and certification</td>
<td>1 Contract</td>
<td>1 per contract</td>
<td>AS/NZS 4671</td>
</tr>
<tr>
<td>Steel reinforcement</td>
<td>1 Contract</td>
<td>1 per contract</td>
<td>AS/NZS 4671</td>
<td></td>
</tr>
<tr>
<td>Steel fibre</td>
<td>1 Contract</td>
<td>1 per contract</td>
<td>ASTM A 820/820m</td>
<td></td>
</tr>
</tbody>
</table>

Sub-Annexure C13 Placement of continuously reinforced concrete base
(1135 Continuously reinforced concrete base)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel supply</td>
<td>Material quality –</td>
<td>1 Contract</td>
<td>1 per contract</td>
<td>AS/NZS 4671</td>
</tr>
</tbody>
</table>
### Activity: Key quality verification requirements | Maximum lot size | Minimum test frequency | Test method
---|---|---|---
Supplier's documentary evidence and certification | | | |
Concrete supply | Refer Sub-Annexure C14: Ready-mixed concrete production and supply | | |
Concrete/air temperature | A production lot | As required by Superintendent | Measure
Air content | 1 Contract | 1 per contract | AS 1012.4.2 Method 2
Consistency - Slump | 50 m³ | 1 per load | AS 1012.3.1 AS 1012.3.3
Compressive strength (7 day) | 50 m³ | 1 pair per 50 m³ | AS 1012.1 AS 1012.8.1 AS 1012.9
Compressive strength (28 day) | 50 m³ | 1 pair per 50 m³ | AS 1012.1 AS 1012.8.1 AS 1012.9
Drying shrinkage | 1 day's production or 150 m³ (whichever is the lesser) | 3 per lot | AS 1012.13
Placement | Relative compaction | | |
- Machine placed | 50 m³ | 1 per 50 m³ | AS 1012.14
- Hand placed | Area between 2 consecutive const. joints | 2 per lot | AS 1012.14
Thickness | 50 m³ | 5 m grid on plan area | Survey
Geometry | 50 m³ | 1 cross section per 15 m | Survey 3 m Straight Edge
Ride quality | Profile factor | | |
Surface texture | Texture depth | | |
Curing | Material quality— Supplier's documentary evidence and certification | 1 contract | 1 per production batch | AS 3799 AS 1160
Application rate | 1 day's work | 1 per 1000 m² | |
Joints | Material quality—Sealant supplier's documentary evidence and certification | 1 contract | 1 per production batch | |
Geometry | 1 day's work | All joints | Survey & 3 m Straight edge | |

Sub-annexure C14 Ready-mixed concrete production & supply
(0319 Minor concrete works, 1131 Rolled concrete subbase, 1132 Lean mix concrete subbase, 1133 Plain and reinforced concrete base, 1134 Steel fibre reinforced concrete base, 1135 Continuously reinforced concrete base)

### Activity: Key quality verification requirements | Maximum lot size | Minimum test frequency | Test method
---|---|---|---
Raw materials supply | Material quality— Supplier's documentary evidence and certification | | |
<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>of:</td>
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<td>1 per month</td>
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<td>AS 3583.13, AS 1289.4.2.1</td>
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<td>Admixtures</td>
<td>1 mth's prod'n</td>
<td>1 per month</td>
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<td>Fine aggregates</td>
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<tr>
<td>- Grading</td>
<td>1 wk's prod'n</td>
<td>1 per 200 m³</td>
<td>AS 1141.11.1</td>
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<tr>
<td>- Moisture content</td>
<td>N/A</td>
<td>1 per day</td>
<td></td>
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<tr>
<td>- Sulphate soundness</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1141.24</td>
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<tr>
<td>- Bulk density</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 2758.1</td>
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</tr>
<tr>
<td>- Unit mass (Particle density)</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 2758.1</td>
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<tr>
<td>- Water absorption</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 2758.1</td>
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<tr>
<td>- Material finer 2 μm</td>
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<td>1 per contract</td>
<td>AS 2758.1</td>
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<tr>
<td>- Deleterious material (Impurities/reactive)</td>
<td>1 contract</td>
<td>1 per contract</td>
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<td>Coarse aggregates:</td>
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<td>1 wk's prod'n</td>
<td>1 per 200 m³</td>
<td>AS 1141.11.1</td>
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<td>1 per day</td>
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<td>- Wet strength</td>
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<td>AS 1141.22</td>
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<tr>
<td>- Wet/dry strength variation</td>
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<td>1 per contract</td>
<td>AS 1141.22</td>
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<td>- Sulphate soundness</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1141.24</td>
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<tr>
<td>- Particle shape</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1141.14</td>
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<td>- Fractured faces</td>
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<td>1 per contract</td>
<td>AS 1141.18</td>
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<td>- Bulk density</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 2758.1</td>
<td></td>
</tr>
<tr>
<td>- Unit mass (Particle density)</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 2758.1</td>
<td></td>
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<tr>
<td>- Water absorption</td>
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<td>1 per contract</td>
<td>AS 2758.1</td>
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<td>- Material finer 75 μm</td>
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<td>AS 2758.1</td>
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<td>- Weak particles</td>
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<td>1 per contract</td>
<td>AS 2758.1</td>
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<tr>
<td>- Light particles</td>
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<td>1 per contract</td>
<td>AS 2758.1</td>
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<tr>
<td>- Deleterious materials (impurities/reactive)</td>
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<td>1 per contract</td>
<td>AS 2758.1</td>
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<td>- Iron unsoundness</td>
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<td>1 per contract</td>
<td>AS 2758.1</td>
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<tr>
<td>- Falling/dusting unsoundness</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 2758.1</td>
<td></td>
</tr>
<tr>
<td>Mix design</td>
<td>Compressive strength</td>
<td>1 contract mix</td>
<td>AS 1012.9</td>
<td></td>
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<tr>
<td></td>
<td>Aggregate moisture content</td>
<td>1 contract mix</td>
<td>AS 1012.9</td>
<td></td>
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<tr>
<td></td>
<td>Consistency—Slump</td>
<td>1 contract mix</td>
<td>AS 1012.3.1</td>
<td></td>
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<tr>
<td></td>
<td>Air content</td>
<td>1 contract mix</td>
<td>AS 1012.4.2 Method 2</td>
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### Activity

<table>
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<tr>
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<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
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<tbody>
<tr>
<td>Shrinkage</td>
<td></td>
<td>1 contract mix</td>
<td>1 per mix per contract</td>
<td>AS 1012.13</td>
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* Note: or part thereof, per lot.

### Sub-annexure C15 Segmental paving

**(1145 Segmental paving)**

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<tr>
<th>Activity</th>
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<th>Maximum lot size</th>
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<th>Test method</th>
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</thead>
<tbody>
<tr>
<td>Materials supply</td>
<td>Material quality—Supplier’s documentary evidence and certification of:</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>-Concrete segmental paving units</td>
<td>1 contract</td>
<td>1 per contract</td>
<td></td>
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<tr>
<td>-Clay segmental paving units</td>
<td>1 contract</td>
<td>1 per contract</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Bedding sand</td>
<td>Grading</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 1141.11.1</td>
</tr>
<tr>
<td>-Joint filling sand</td>
<td>Grading</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 1141.11.1</td>
</tr>
<tr>
<td>Base</td>
<td>Geometry</td>
<td>One layer 5000 m², max 1 day’s placement</td>
<td>One cross section per 25 m</td>
<td>Survey</td>
</tr>
<tr>
<td>Surface quality</td>
<td>One layer 5000 m², max 1 day’s placement</td>
<td>10 per 200 m² or lot</td>
<td>3 m Straight Edge</td>
<td></td>
</tr>
<tr>
<td>Edge restraints</td>
<td>Refer ‘Minor concrete works’</td>
<td>1 day’s placement</td>
<td>1 per 10 lin m</td>
<td>Measure/ Survey</td>
</tr>
<tr>
<td>Laying paver units</td>
<td>Joint width</td>
<td>1 day’s placement</td>
<td>All joints</td>
<td>Measure</td>
</tr>
<tr>
<td></td>
<td>Geometry</td>
<td>1 day’s placement</td>
<td>One cross section per 15 m</td>
<td>Survey</td>
</tr>
<tr>
<td></td>
<td>Surface quality</td>
<td>1 day’s placement</td>
<td>10 per 200 m² or lot</td>
<td>3 m Straight Edge</td>
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### Sub-annexure C16 Bituminous slurry surfacing

**1146 Bituminous slurry surfacing**

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<th>Minimum test frequency</th>
<th>Test method</th>
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<tbody>
<tr>
<td><strong>Materials supply</strong></td>
<td>Material Quality—Supplier's documentary evidence and certification of:</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- Bitumen (prior to emulsification)</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 2008</td>
</tr>
<tr>
<td></td>
<td>- Bitumen Emulsion</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Residual Binder Content (Residue from Evaporation)</td>
<td>1 contract</td>
<td>2 per bulk delivery</td>
<td>AS 1160, App.D</td>
</tr>
<tr>
<td></td>
<td>- Mineral aggregates</td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>Degradation factor</td>
<td>1 contract</td>
<td>1 per contract or 6 month period</td>
<td>AS 1141.25.3</td>
</tr>
<tr>
<td></td>
<td>Los Angeles value</td>
<td>1 contract</td>
<td>1 per contract or 6 month period</td>
<td>AS 1141.23</td>
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<tr>
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<td>Aggregate wet strength</td>
<td>1 contract</td>
<td>1 per contract or 6 month period</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td></td>
<td>Wet/dry strength variation</td>
<td>1 contract</td>
<td>1 per contract or 6 month period</td>
<td>AS 1141.22</td>
</tr>
<tr>
<td></td>
<td>Polished aggregate friction value</td>
<td>1 contract</td>
<td>1 per contract or 6 month period</td>
<td>AS 1141.42</td>
</tr>
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<td>Sand equivalent</td>
<td>1 contract</td>
<td>1 per contract or 6 month period</td>
<td>AS 1289.3.7.1</td>
</tr>
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<td>- Mineral filler</td>
<td>1 month's prod'n</td>
<td>1 per contract or 6 month period</td>
<td>AS 2150</td>
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<td></td>
<td>- Combined aggregate grading</td>
<td>1 contract</td>
<td>1 per contract or 6 month period</td>
<td>AS 1141.11.1 AS 1141.12</td>
</tr>
<tr>
<td>Mix design – Nominated mix</td>
<td>Approval of mix and NATA certification —Supplier's documentary evidence and certification</td>
<td>1 contract</td>
<td>1 per mix</td>
<td></td>
</tr>
<tr>
<td>Mix properties</td>
<td>Wear loss</td>
<td>1 contract</td>
<td>1 per mix</td>
<td>ISSN TB 100</td>
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<td></td>
<td>Traffic time</td>
<td>1 contract</td>
<td>1 per mix</td>
<td>ISSN TB 139</td>
</tr>
<tr>
<td></td>
<td>Adhesion</td>
<td>1 contract</td>
<td>1 per mix</td>
<td>ISSN TB 114 or ISSN TB 144</td>
</tr>
<tr>
<td>Production mix</td>
<td>Grading Residual binder content</td>
<td>1 day's prod'n or 50 m³ (whichever is the lesser)</td>
<td>2 per 50 m³ or 2 per 50 m³</td>
<td>AS/NZS 2891.3 .1 AS 1160</td>
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<tr>
<td>Laying</td>
<td>Levels</td>
<td>1 layer, max 200 m³</td>
<td>1 cross section per 15 m</td>
<td>Survey</td>
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### Sub-annexure C17 Pavement markings
(1191 Pavement markings)

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<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials supply</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Paint</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 4049.3</td>
</tr>
<tr>
<td></td>
<td>- Glass beads</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 2009</td>
</tr>
<tr>
<td></td>
<td>- Thermoplastic material</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 4049.2</td>
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<td>- Raised pavement markers</td>
<td>1 contract</td>
<td>1 per contract or change in material</td>
<td>AS 1906.3</td>
</tr>
<tr>
<td>Paint application</td>
<td>Wet film thickness</td>
<td>1 contract</td>
<td>1 per site visit or change in pressure settings</td>
<td>AS/NZS 1580.1 07.3</td>
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<td></td>
<td>Application rate of glass beads</td>
<td>1 contract</td>
<td>1 per site visit or change in pressure settings</td>
<td>1191 Pavement markings Annexure A</td>
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<tr>
<td>Thermoplastic Application</td>
<td>Cold film thickness</td>
<td>1 contract</td>
<td>1 per site visit or change in pressure settings</td>
<td>Measure by micrometer</td>
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<td>Application rate of glass beads</td>
<td>1 contract</td>
<td>1 per site visit or change in pressure settings</td>
<td>1911 Pavement markings Annexure A</td>
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### Sub-annexure C18 Signposting
(1192 Signposting)

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<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
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<tbody>
<tr>
<td>Materials supply</td>
<td>Material quality— Supplier's documentary evidence and certification of:</td>
<td></td>
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<tr>
<td></td>
<td>- Sign blanks</td>
<td>1 contract</td>
<td>1 per contract, or change in material</td>
<td>AS 1743</td>
</tr>
<tr>
<td></td>
<td>- Aluminium extrusion</td>
<td>1 contract</td>
<td>1 per contract, or</td>
<td>AS 1866</td>
</tr>
<tr>
<td>Activity</td>
<td>Key quality verification requirements</td>
<td>Maximum lot size</td>
<td>Minimum test frequency</td>
<td>Test method</td>
</tr>
<tr>
<td>----------</td>
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</tr>
<tr>
<td>backings</td>
<td>change in material</td>
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<td></td>
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</tr>
<tr>
<td>- Retro-reflective material</td>
<td>1 contract</td>
<td>1 per contract, or change in material</td>
<td>AS 1743</td>
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<tr>
<td>- Non-reflective paint</td>
<td>1 contract</td>
<td>1 per contract, or change in material</td>
<td>AS 2311</td>
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<tr>
<td>- Non-reflective sheet material</td>
<td>1 contract</td>
<td>1 per contract, or change in material</td>
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<tr>
<td>- Steel sign support structures</td>
<td>1 contract</td>
<td>1 per contract, or change in material</td>
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<tr>
<td>- Grade</td>
<td>1 contract</td>
<td>1 per contract, or change in material</td>
<td>AS 1627.9</td>
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<tr>
<td>- Protective treatment</td>
<td>1 contract</td>
<td>1 per contract, or change in material</td>
<td>AS 4680 and AS 1214</td>
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<tr>
<td>Concrete foundations</td>
<td>Refer 'Minor concrete works'</td>
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**Sub-annexure C19 Minor concrete works**

*(0319 Minor concrete works)*

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<tr>
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<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade</td>
<td>Compaction</td>
<td>1000 lin m or 1000 m²</td>
<td>1 per 200 lin m or 200 m²</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>Gravel subbase construction</td>
<td>Compaction</td>
<td>1 day's placement</td>
<td>1 per 100 lin m or 100 m²</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td></td>
<td>Subbase geometry</td>
<td>1 day's placement</td>
<td>1 per 25 lin m</td>
<td>3 m straight edge</td>
</tr>
<tr>
<td>Steel supply</td>
<td>Material quality—Suppliers documentary evidence and certification</td>
<td>1 delivery</td>
<td>1 per production batch</td>
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<td>Concrete supply</td>
<td>Refer Sub-Annexure C14: Ready-mixed concrete production and supply</td>
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<td>Consistency—Slump</td>
<td>15 m³</td>
<td>1 per load</td>
<td>AS 1012.3.1</td>
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<td></td>
<td>Compressive strength (7 and 28 day)</td>
<td>15 m³</td>
<td>2 pairs per 15 m³</td>
<td>AS 1012.1 AS 1012.8.1 AS 1012.9</td>
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<tr>
<td>Concrete placement</td>
<td>Finished Levels</td>
<td>15 m³</td>
<td>1 cross section per 15 m</td>
<td>Survey and 3 m straight edge</td>
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<td>Surface dimensions</td>
<td>Single fabrication</td>
<td>As required to confirm design dimensions</td>
<td>measure</td>
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<td>Backfilling</td>
<td>Material quality:</td>
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<td></td>
<td>- Maximum particle size</td>
<td>1 contract/ material type</td>
<td>1 per 200 m³ or lot</td>
<td>AS 1289.3.3.1</td>
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<td>- Plasticity index</td>
<td>1 contract/ material type</td>
<td>1 per 200 m³ or lot</td>
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### Activity | Key quality verification requirements |
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<th></th>
<th></th>
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</thead>
<tbody>
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<td>Compaction</td>
<td>1 day's work or max 200 m²</td>
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<tr>
<td>Sprayed concrete</td>
<td>Test panels and cores</td>
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<td>1 contract</td>
</tr>
<tr>
<td>Compressive strength cores</td>
<td>15 m³</td>
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<td>Curing material quality—Supplier's documentary evidence and certification</td>
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<table>
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<td>Seed</td>
<td>Certification of authenticity for the prescribed mix</td>
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<td>Imported topsoil</td>
<td>Material quality:</td>
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<td>- pH 10,000 m² 1 per 500 m³ *</td>
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<tr>
<td></td>
<td>- Organic content 10,000 m² 1 per 500 m³ *</td>
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<tr>
<td></td>
<td>- Soluble salt content 10,000 m² 1 per 500 m³ *</td>
</tr>
<tr>
<td>Mulch for planting</td>
<td>Material quality 1 Contract</td>
</tr>
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</table>

* Note: or part thereof, per lot.

### Sub-annexure C21 Masonry walls (0292 Masonry walls)

<table>
<thead>
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</thead>
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<tr>
<td>Alignment</td>
<td>Set out</td>
</tr>
<tr>
<td>Footing</td>
<td>Concrete slump</td>
</tr>
<tr>
<td></td>
<td>Concrete strength</td>
</tr>
<tr>
<td>Concrete grout</td>
<td>Strength</td>
</tr>
<tr>
<td>Backfilling</td>
<td>Drainage layer grading</td>
</tr>
<tr>
<td>Foundations and backfill</td>
<td>Compaction</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment</td>
<td>Set out</td>
</tr>
<tr>
<td>Footing</td>
<td>Concrete slump</td>
</tr>
<tr>
<td>Concrete grout</td>
<td>Strength</td>
</tr>
<tr>
<td>Backfilling</td>
<td>Drainage layer grading</td>
</tr>
<tr>
<td>Foundations and backfill</td>
<td>Compaction</td>
</tr>
</tbody>
</table>

### Sub-annexure C20 Landscape – roadways and street trees

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed</td>
<td>Certification of authenticity for the prescribed mix</td>
</tr>
<tr>
<td>Imported topsoil</td>
<td>Material quality:</td>
</tr>
<tr>
<td></td>
<td>- pH 10,000 m² 1 per 500 m³ *</td>
</tr>
<tr>
<td></td>
<td>- Organic content 10,000 m² 1 per 500 m³ *</td>
</tr>
<tr>
<td></td>
<td>- Soluble salt content 10,000 m² 1 per 500 m³ *</td>
</tr>
<tr>
<td>Mulch for planting</td>
<td>Material quality 1 Contract</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment</td>
<td>Set out</td>
</tr>
<tr>
<td>Footing</td>
<td>Concrete slump</td>
</tr>
<tr>
<td>Concrete grout</td>
<td>Strength</td>
</tr>
<tr>
<td>Backfilling</td>
<td>Drainage layer grading</td>
</tr>
<tr>
<td>Foundations and backfill</td>
<td>Compaction</td>
</tr>
</tbody>
</table>

* Note: or part thereof, per lot.
Sub-annexure C22 Crib retaining walls
(0293 Crib retaining walls)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment</td>
<td>Set out</td>
<td>Contract</td>
<td>25 m sections</td>
<td>Survey</td>
</tr>
<tr>
<td>Footing</td>
<td>Concrete slump</td>
<td>Contract</td>
<td>1 per load</td>
<td>AS 1012.3.1</td>
</tr>
<tr>
<td></td>
<td>Concrete strength</td>
<td>Contract</td>
<td>1 per contract or 100 m³ (whichever is the lesser)</td>
<td>AS 1012.9</td>
</tr>
<tr>
<td>Backfilling</td>
<td>Quality and plasticity</td>
<td>Contract</td>
<td>1 per contract</td>
<td>AS 1289.3.3.1</td>
</tr>
<tr>
<td></td>
<td>Drainage layer grading</td>
<td>Concrete</td>
<td>1 per contract</td>
<td>AS 1141.11.1</td>
</tr>
<tr>
<td>Foundations and backfill</td>
<td>Compaction</td>
<td>Contract or 200 lineal metres (whichever is the lesser)</td>
<td>3 per 200 lineal metres</td>
<td>AS 1289.5.4.1</td>
</tr>
</tbody>
</table>

Sub-annexure C23 Water supply - reticulation
(1341 Water supply - reticulation (Construction))

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials supply</td>
<td>Material quality—Supplier’s documentary evidence and certification of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- uPVC pipes</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1477</td>
</tr>
<tr>
<td></td>
<td>- Ductile iron pipes</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 2280 and AS 2129</td>
</tr>
<tr>
<td></td>
<td>- Copper pipe</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1432</td>
</tr>
<tr>
<td></td>
<td>- Polyethylene pipe</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS/NZS 4130</td>
</tr>
<tr>
<td></td>
<td>- Stop valves material</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS/NZS 2638.1, AS/NZS 2638.2 and AS 2129</td>
</tr>
<tr>
<td></td>
<td>- Non return valves</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 4794</td>
</tr>
<tr>
<td></td>
<td>- Spring hydrants</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 3952</td>
</tr>
<tr>
<td>Siting and excavation</td>
<td>Geometry</td>
<td>1 line</td>
<td>1 per line</td>
<td>Survey</td>
</tr>
<tr>
<td>Bedding</td>
<td>Material quality—Grading</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS/NZS 2032</td>
</tr>
<tr>
<td>Thrust and anchor blocks</td>
<td>Refer sub-annexure C13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete encasement</td>
<td>Refer sub-annexure C13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chamber covers and frames</td>
<td>Geometry</td>
<td>1 cover/frame</td>
<td>1 per cover/frame</td>
<td>survey</td>
</tr>
<tr>
<td>Testing of pipelines</td>
<td>Pressure testing</td>
<td>1 line</td>
<td>1 per line</td>
<td>As specified 1341 Water supply — reticulation clause 4.8</td>
</tr>
<tr>
<td>Backfill and compaction</td>
<td>Compaction</td>
<td>1 line</td>
<td>1 per 2 layers max 100 m²</td>
<td>AS 1289.5.6.1 or AS 1289.5.7.1</td>
</tr>
</tbody>
</table>
## Sub-annexure C24 Sewerage system - reticulation

### (1361 Sewerage system - reticulation (Construction))

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials supply</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Material quality—Supplier’s documentary evidence and certification of:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- uPVC pipes</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS/NZS 1477</td>
<td></td>
</tr>
<tr>
<td>- Ductile iron pipes</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS/NZS 2280 and AS 2129</td>
<td></td>
</tr>
<tr>
<td>- Vitrified clay pipes</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 1741</td>
<td></td>
</tr>
<tr>
<td>- Precast access chambers</td>
<td>1 contract</td>
<td>1 per contract</td>
<td>AS 4198</td>
<td></td>
</tr>
<tr>
<td><strong>Siting and excavation</strong></td>
<td>Geometry</td>
<td>1 line/structure</td>
<td>1 per line/structure</td>
<td>Survey</td>
</tr>
<tr>
<td><strong>Bedding</strong></td>
<td>Material quality—Grading</td>
<td>1 contract</td>
<td>1 per contract per source</td>
<td>AS 1152</td>
</tr>
<tr>
<td><strong>Concrete bedding</strong></td>
<td>Refer Sub-Annexure C13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Laying and jointing of pipes, access chambers, structures</strong></td>
<td>Geometry</td>
<td>1 line</td>
<td>1 per line</td>
<td>Survey</td>
</tr>
<tr>
<td><strong>Thrust and anchor blocks</strong></td>
<td>Refer Sub-Annexure C13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Concrete encasement</strong></td>
<td>Refer Sub-Annexure C13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cast in situ access chambers</strong></td>
<td>Material quality:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Tri-calcium aluminate content</td>
<td>1 contract</td>
<td>1 per contract per source</td>
<td>AS 3972</td>
<td></td>
</tr>
<tr>
<td>- Fineness index</td>
<td>1 contract</td>
<td>1 per contract per source</td>
<td>AS 3972</td>
<td></td>
</tr>
<tr>
<td>- Minimum cement content</td>
<td>1 contract</td>
<td>1 per contract per source</td>
<td>AS 3972</td>
<td></td>
</tr>
<tr>
<td><strong>Acceptance test of gravitation mains &amp; access chambers</strong></td>
<td>- Compressed air testing</td>
<td>1 line</td>
<td>1 per line</td>
<td>As specified 1361 Sewerage systems – reticulation clause 4.9.</td>
</tr>
<tr>
<td></td>
<td>- Hydrostatic testing</td>
<td>1 per test length</td>
<td>1 per line</td>
<td>1361 Sewerage systems – reticulation clause 4.9.</td>
</tr>
<tr>
<td><strong>Backfill and compaction</strong></td>
<td>Compaction</td>
<td>1 line</td>
<td>1 per 2 layers max 100 m²</td>
<td>AS 1289.5.7.1</td>
</tr>
</tbody>
</table>

## Sub-annexure C25 Water supply - pump stations

### (1342 Water supply – pump stations (Construction))

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Backfill and compaction</strong></td>
<td>Compaction</td>
<td>1 line</td>
<td>1 per 2 layers max 100 m²</td>
<td>AS 1289.5.7.1</td>
</tr>
<tr>
<td>Activity</td>
<td>Key quality verification requirements</td>
<td>Maximum lot size</td>
<td>Minimum test frequency</td>
<td>Test method</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>----------------------------------------------------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>-----------------------------------------------------------------</td>
</tr>
<tr>
<td>Switchgear and controlgear assembly</td>
<td>Electrical function</td>
<td>each installation</td>
<td>1 test per installation</td>
<td>As specified 1342 Water supply– pump stations clause 4.6</td>
</tr>
<tr>
<td>Commissioning of pumping station</td>
<td>Certification testing of electrical installation in accordance with relevant Australian Standards</td>
<td>1 installation</td>
<td>1 per installation</td>
<td>As specified 1342 Water supply – pump stations clause 4.9</td>
</tr>
</tbody>
</table>

Sub-annexure C26 Sewerage systems - pump stations
(1362 Sewerage systems – pump stations (Construction))

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switchgear and controlgear assembly</td>
<td>Electrical compliance</td>
<td>each installation</td>
<td>1 test per installation</td>
<td>AS/NZS 3439</td>
</tr>
<tr>
<td>Commissioning of pumping station</td>
<td>Certification testing of electrical installation in accordance with relevant Australian Standards</td>
<td>1 installation</td>
<td>1 per installation</td>
<td>As specified 1362 Sewerage systems – pump stations clause 4.8</td>
</tr>
</tbody>
</table>

Sub-annexure C27 Construction of pathways and cycleways
(0282 Pathways and cycleways (Construction))

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key quality verification requirements</th>
<th>Maximum lot size</th>
<th>Minimum test frequency</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgrade</td>
<td>Compaction</td>
<td>1000 lin m or 1000 m²</td>
<td>1 per 200 lin m or 200 m²</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>Subbase/ Granular base placement</td>
<td>Compaction</td>
<td>1 day’s placement</td>
<td>1 per 100 lin m or 100 m²</td>
<td>AS 1289.5.4.1</td>
</tr>
<tr>
<td>Geometry</td>
<td>Geometry</td>
<td>1 day’s placement</td>
<td>1 per 25 lin m</td>
<td>3 m straight edge</td>
</tr>
<tr>
<td>Steel supply</td>
<td>Material quality—Suppliers documentary evidence and certification</td>
<td>1 delivery</td>
<td>1 per production batch</td>
<td></td>
</tr>
<tr>
<td>Concrete supply</td>
<td>Refer Sub-Annexure C14: Ready-mixed concrete production and supply</td>
<td>15 m³</td>
<td>1 per load</td>
<td>AS 1012.3.1</td>
</tr>
<tr>
<td></td>
<td>Consistency—Slump</td>
<td>15 m³</td>
<td>2 pairs per 15 m³</td>
<td>AS 1012.1 AS 1012.8.1 AS 1012.9</td>
</tr>
<tr>
<td></td>
<td>Compressive strength (28 days)</td>
<td>15 m³</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete placement</td>
<td>Finished Levels</td>
<td>15 m³</td>
<td>1 cross section per 15 m</td>
<td>Survey and 3 m straight</td>
</tr>
<tr>
<td>Activity</td>
<td>Key quality verification requirements</td>
<td>Maximum lot size</td>
<td>Minimum test frequency</td>
<td>Test method</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------</td>
<td>------------------</td>
<td>------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single fabrication</td>
<td>As required to confirm design dimensions</td>
<td>Measure</td>
</tr>
<tr>
<td></td>
<td>Surface dimensions</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Annexure D – Matrix for compliance with AS/NZS ISO 9001 and this specification.

<table>
<thead>
<tr>
<th>Clause</th>
<th>AS/NZS ISO 9001</th>
<th>Records</th>
<th>Project quality plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>QMS.</td>
<td>-Project quality plan.</td>
<td>-QMS and procedures.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Quality manual.</td>
<td>-Matrix for QMS.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Subcontractor and supply/deliver Contractors compliance.</td>
</tr>
<tr>
<td>2.2</td>
<td>Control of documents</td>
<td>-List of who holds issued documents.</td>
<td>-Description of how quality records will be stored and maintained.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Register of current document issued/revision.</td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Management responsibility</td>
<td>-Corporate QMS.</td>
<td>-List of responsibilities and authorities for Quality Assurance activities.</td>
</tr>
<tr>
<td>2.4</td>
<td>Resource management</td>
<td>-Provision of resources.</td>
<td>-</td>
</tr>
<tr>
<td>2.5</td>
<td>Design and development</td>
<td>-Design records.</td>
<td></td>
</tr>
<tr>
<td>2.5, 2.11 and 2.12</td>
<td>Purchasing</td>
<td>-Evaluation of Subcontractors and Suppliers.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Surveillance, audit of Subcontractors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Subcontractor supplied documentation.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Certificate of testing by Suppliers.</td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Control of production and service provision</td>
<td>-Procedures describing how to control work processes.</td>
<td>-Method and results of Subcontractor evaluation for process validation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Records demonstrating effectiveness of work process controls.</td>
<td>-Supply/delivery/Subcontractor quality plan.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Records of process validation when applicable.</td>
<td></td>
</tr>
<tr>
<td>2.6</td>
<td>Identification and traceability</td>
<td>-Product batch/traceability records.</td>
<td>-Method of maintaining traceability.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Lot identification register.</td>
<td>-Method of subdividing the work into lots and allocating lot numbers.</td>
</tr>
<tr>
<td>2.6 and 2.9</td>
<td>Control of monitoring and measuring devices</td>
<td>-Calibration certificates.</td>
<td>-Procedure for inspections, testing and closing out work lots.</td>
</tr>
<tr>
<td>2.7</td>
<td>Inspection and test planning</td>
<td>-ITP’s.</td>
<td></td>
</tr>
<tr>
<td>Clause</td>
<td>AS/NZS ISO 9001</td>
<td>Records</td>
<td>Project quality plan</td>
</tr>
<tr>
<td>--------</td>
<td>----------------</td>
<td>---------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Conformity reports for each completed lot.</td>
<td>-How to keep records of inspection and test results. -ITP and forms. -Method for identifying, controlling and verifying inspection and test status.</td>
</tr>
<tr>
<td>2.8</td>
<td>Monitoring and measurement</td>
<td>-Hold Point and Witness Point schedule. -Inspection and test records.</td>
<td>-Method for release of Hold Points.</td>
</tr>
<tr>
<td>2.10</td>
<td>Control of nonconforming product</td>
<td>-Nonconformity reports. -Notifications of nonconformity register.</td>
<td>-Method of registering and closing nonconformance.</td>
</tr>
<tr>
<td></td>
<td>Corrective action</td>
<td>-Corrective action reports and register. -Corrective action requests.</td>
<td>-Method of ensuring against corrective action.</td>
</tr>
</tbody>
</table>
0257 LANDSCAPE – ROADWAYS AND STREET TREES

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide vegetation as documented to the following areas:
- Cut and fill batters
- Pathway verges
- Median areas and open drains, and
- Street tree planting.

Requirement: Lake Macquarie City Council’s Landscaping Guidelines and the industry standard Water by Design Guidelines over-ride the requirements outlined in this specification.

Performance
Requirements: [complete/delete]

Erosion control: To 1102 Control of erosion and sedimentation.
Selections: Conform to the selections in Annexure A.

Design
Authority requirements: Conform to the following:
- Statutory requirements for Work Health and Safety.
- Individual State and Local Council planting lists.

1.2 WWW.PLANET.RBG.SYD.NSW.GOV.AU CROSS REFERENCES

General
Requirement: Conform to the following worksections:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1102 Control of erosion and sedimentation.
- 1112 Earthworks (Roadways).
- 1424 Landscape - maintenance.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents incorporated in this worksection by reference:

AS 1160-1996 Bituminous emulsions for the construction and maintenance of pavements
AS 2507-1998 The storage and handling of agricultural and veterinary chemicals
AS 4419-2003 Soils for landscaping and garden use
AS 4454-2012 Composts, soil conditioners and mulches
AS 4843-2001 Synthetic weed blocking fabric

Lake Macquarie City Council
Landscaping Guidelines
Water by Design Guidelines

1.4 STANDARDS

General
Storage and handling of pesticides: To AS 2507.
1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:

Definitions
General: For the purposes of this worksection the following definitions:
Ameliorant: Material used to make or improve soil.
Anionic bitumen: A type of bituminous emulsion where dispersed particles comprise a bituminous binder and are negatively charged.

1.6 SUBMISSIONS

Soil tests for imported topsoil
Report: Submit a certificate noting the:
- Suitability of each soil type for its specified use.
- Similarity to naturally occurring local soil.
- Suitability for establishment and on-going viability of the site specified vegetation.
- Absence of any weed propagules or contaminants.
- Maintenance schedule.

Ameliorants recommendation: If required to include ameliorants, recommend the source of ameliorant material, rates and methods of incorporation.

Samples
General: Submit representative samples of each material, packed to prevent contamination and labelled to indicate source and content.
Bulk materials: Submit a 5 kg sample of each type specified. Submit bulk material samples, with required test results, at least 10 working days before bulk deliveries.

Seed
Supply: Submit the name/s of the proposed seed supplier/s.
Timing: Within 2 weeks of the acceptance of the tender.
Lead time for native seed: Notify the lead time that may be required to procure native seed species.

Plant provenance
Locality: Provide written certification that all plant material has been grown from locally provenanced stock. If this is not achievable give notice.
Species: Provide written certification that all plant material is true to the required species and type.

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>PRE-CONSTRUCTION PLANNING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transportation</td>
<td>Inspect plants upon delivery to ensure no physical damage or drying out</td>
<td>3 working days prior to transporting</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>

**WITNESS POINTS Table**

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection by the Superintendent</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slopes and drains – Preparation</td>
<td>Maintain sprayed areas undisturbed for 2 weeks</td>
<td>2 weeks</td>
</tr>
</tbody>
</table>
### Clause/subclause
<table>
<thead>
<tr>
<th>Requirement</th>
<th>Notice for inspection by the Superintendent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slopes and drains – Seed mixing</td>
<td>Notice prior to sowing</td>
</tr>
<tr>
<td>Slopes and drains – Watering</td>
<td>Check for excessive rilling</td>
</tr>
<tr>
<td>Transplanting street trees – General</td>
<td>Give notice for watering, fertilising root cutting</td>
</tr>
<tr>
<td>Transplanting street trees – maintenance of on-site plant material</td>
<td>Program for regular fertiliser applications</td>
</tr>
<tr>
<td>Transplanting street trees – Above ground</td>
<td>Approval for pruning of branches</td>
</tr>
</tbody>
</table>

### 2 PRE-CONSTRUCTION PLANNING

#### 2.1 SPECIMEN PLANTS

**Properties**
- **Source:** From locations where these plant materials are growing in ‘natural’ ground conditions. Non-containerised nursery stock: Required.
- **Presentation:** Provide maximum initial impact at the time of project opening.
- **Properties:** To the **Specimen plants schedule**.
- **Preparation:** Program the preparation of specimen plants and preparation works to assure readiness of specimen plants for transplanting to site when required.

**Transportation**
- **Responsibility:** Ensure plants are transported to the site without physical damage or drying out. This is a **HOLD POINT**.

*Freight responsibility agreement: [complete/delete]*

### 3 MATERIALS

#### 3.1 SELECTIONS

**General**
- **Selections:** To **Annexure A**.

#### 3.2 TOPSOIL – MINOR WORKS

**General**
- **Source:** Imported topsoil and/or topsoil won and stockpiled on site to **1112 Earthworks - Roadways**.
- **Standard:** To **AS 4419**.
- **Topsoil description:**
  - Of a friable, porous nature.
  - Free of weeds and weed seeds, bulbs, corms and vegetable propagules.
  - Free of refuse or materials toxic to humans, animals or plants.
  - Free of stumps, roots, clay lumps or stones larger than 50 mm in size.
  - Minimum organic content: 3% by mass.
  - pH range: 5.5 to 7.5.
  - Maximum soluble salt content: 0.06% by mass.

**Health warning:** Provide a health warning to conform with **AS 4419** on packaging or invoice for bulk supply.

#### 3.3 FERTILISER AND MULCHES

**Fertiliser**
- **Type:** Organic.
- **NPK ratio:**

**Vegetable mulch**

Hydromulch: Straw, chaff, wood fibre paper pulp finely shredded to a maximum dimension of 10 mm.
Prohibited material: Meadow hay and weeds.
Binder: Grade ASS slow setting anionic bitumen to AS 1160.

**Straw mulching**

Material: Straw matrix.
Prohibited material: Meadow hay and weeds.
Binder: Grade ASS slow setting anionic bitumen to AS 1160.
Straw mat finished thickness: > 20 mm.

**Mulch types**

Organic landscape mulch: To AS 4454.
- Composition:
  - Fines: < 5% by volume.
  - Woodchip: Maximum size < 50 mm.
  - Leaf mulch: < 25% by volume.
Quality: Free of weeds and allopathic organisms.
Synthetic weed blocking fabric: To AS 4843.

**Hardwood stakes**

Material: Sharpened at one end, as follows:
- Marker stakes (for tube stock): 15 x 15 x 800 mm.
- Stakes (for advanced stock): 2 stakes, 25 x 25 x 2000 mm.
- Stakes (for super advanced stock): 3 stakes, 50 x 50 x 3000 mm.

3.4 ACCESSORIES AND DRAINAGE

**Street tree accessories**

Tree guards:
- Product: [complete/delete]
- Size: [complete/delete]
- Finish: [complete/delete]
Tree grates:
- Product: [complete/delete]
- Size: [complete/delete]
- Size of openings: [complete/delete]
- Material: [complete/delete]
- Finish: [complete/delete]
Trunk collar guards: 200 mm length of 100 mm diameter agricultural pipe split lengthways.

**Street tree subsoil drainage**

Drainage cells:
- Product: [complete/delete]
- Size of cell panel: [complete/delete]
- Filter fabric: [complete/delete]
Location: Planting excavations adjacent roadway kerbing.
Subsoil drainage disposal: [complete/delete]
Describe or refer to 0224 Stormwater – site.
Root barrier:
- Product: [complete/delete]
  - Depth: 600 mm.
Location: Planting excavations adjacent to, and within 4 m, of roadway kerbing.

**Porous bonded gravel**

Tree surround surfacing:
- Product: [complete/delete]
Filter fabric: [complete/delete]
Gravel: [complete/delete]

3.5 PLANT MATERIAL

Seed
Certification: Provide a Certificate of Authenticity for all seed as follows:
- Grass and clover: Pre-packed commercially with an accompanying certificate of germination.
- Native seed: Deliver to the site in separate lots for each species and variety, clearly labelled to show species, variety and weight.

Storage: Do not take possession of the seed more than seven days before sowing is to occur. Store seed in clean, air tight containers and keep away from direct sunlight. Do not expose seed to the elements at any stage during storage.
Seed batch not true to type: Replace.

Turf
Description: 25 mm depth of dense, well rooted, vigorous grass growth with 25 mm depth of topsoil and free of weeds, soil pests and diseases.
Species: To Annexure A.
Prohibited material: Kikuyu grass.
Supply: As rolls in long lengths of uniform width in sound unbroken condition.
Width of rolls: > 300 mm.

Plant material – minor works
Balance (small plants) assessment requirements:
- Tubes or plant cells: Height above soil level must be between 1.5 and 2.5 times the height of the tube or plant cell.
- Trees and shrubs in containers < 20 L (other than tubes or plant cells) or ex-ground trees of size index < 35 (e.g. 1.4 m high x 25 mm calliper); height must fall within the range indicated for the container size in the Small container-grown plant table.
- Containers/rootballs (other than tubes or plant cells) must remain flat on the ground when the stem, held at 80% of height above ground, is deflected 30° from the vertical, side to side.

Plant stock classification: To the Small container-grown plant table.
Plant description:
- Healthy, of good form and not soft or forced.
- Large robust root systems.
- Not rootbound.
- Free from disease and insect pests.
Tree description: Single leading shoot.
Hardening off: Deliver all plants to a site within the locality of the works at least four weeks before planting out.
Plant root systems: Maintain root moisture at all times with particular attention to watering during the on-site period before and during planting.
Planting hole depths: Equal to the depth of container soil.
Fertilising: Submit details of fertiliser to be used and application rate for approval.

Small container-grown plant table

<table>
<thead>
<tr>
<th>Minimum rootball diameter or container size</th>
<th>Height range (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thin-stemmed species</td>
</tr>
<tr>
<td>Tubes or plant cells</td>
<td>Height between 1.5 and 2.5 x the height of the container</td>
</tr>
<tr>
<td>150 mm (1.8 L)</td>
<td>0.4 – 0.6</td>
</tr>
<tr>
<td>170 mm (2.6 L)</td>
<td>0.5 – 0.7</td>
</tr>
<tr>
<td>200 mm pot (4 L)</td>
<td>0.7 – 0.9</td>
</tr>
<tr>
<td>200 mm bag (5 L)</td>
<td>0.8 – 1.0</td>
</tr>
<tr>
<td>250 mm (8 L)</td>
<td>1.0 – 1.2</td>
</tr>
<tr>
<td>300 mm (15 L)</td>
<td>1.2 – 1.5</td>
</tr>
</tbody>
</table>

Plant material – major works
3.6 STREET TREES

General
Labelling: Clearly label individual plants and batches.
- Label type: To withstand transit without erasure or misplacement.

Health
Foliage: Consistent with the size, texture and colour shown in healthy specimens of the nominated species.

Vigour
Extension growth: Consistent with vigorous specimens of the species nominated.

Damage
Supply: Free from damage and from restricted habit due to growth in nursery rows.

Stress
Supply: Free from stress resulting from inadequate watering, excessive shade or excessive sunlight.

Site environment
Grown and hardening off conditions: To suit the conditions that could be reasonably anticipated to exist on site at the time of delivery.

Root development
Final containers: Grow plants in their final containers for the following periods:
- Plants less than 25 L size: over 6 weeks.
- Plants greater than 25 L size: over 12 weeks.

Pests and disease
Supply: Foliage free from attack by pests or disease.

Native species susceptible to attack by native pests
Evidence of previous attack: To no more than 15% of the foliage. Ensure absence of actively feeding insects.

Large trees (Balance)
Conformance at inspection: To balance (large trees) assessment requirements.
Balance (large trees) assessment requirements:
- For trees grown in containers $\geq 20$ L, the size index must lie within the range for the nominal container size shown in the Common container volumes table.
- Ex-ground trees with a size index $\geq 35$ (e.g. $1.4$ m high x $25$ mm calliper) must have rootball diameters $\geq$ the minimum rootball diameters shown in the Ex-ground trees table.

Common container volumes table

<table>
<thead>
<tr>
<th>Size index</th>
<th>Nominal container volume (L)</th>
<th>Size index</th>
<th>Nominal container volume (L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>26-33</td>
<td>20</td>
<td>371-480</td>
<td>450</td>
</tr>
<tr>
<td>32-41</td>
<td>25</td>
<td>412-518</td>
<td>500</td>
</tr>
<tr>
<td>45-58</td>
<td>35</td>
<td>453-587</td>
<td>550</td>
</tr>
<tr>
<td>57-74</td>
<td>45</td>
<td>495-640</td>
<td>600</td>
</tr>
<tr>
<td>77-99</td>
<td>60</td>
<td>533-716</td>
<td>700</td>
</tr>
<tr>
<td>83-107</td>
<td>75</td>
<td>632-818</td>
<td>800</td>
</tr>
<tr>
<td>111-143</td>
<td>100</td>
<td>711-921</td>
<td>900</td>
</tr>
<tr>
<td>154-200</td>
<td>150</td>
<td>791-1023</td>
<td>1000</td>
</tr>
<tr>
<td>194-251</td>
<td>200</td>
<td>842-1089</td>
<td>1100</td>
</tr>
<tr>
<td>227-314</td>
<td>250</td>
<td>918-1188</td>
<td>1200</td>
</tr>
<tr>
<td>273-353</td>
<td>300</td>
<td>1148-1485</td>
<td>1500</td>
</tr>
<tr>
<td>289-373</td>
<td>350</td>
<td>1530-1980</td>
<td>2000</td>
</tr>
<tr>
<td>330-427</td>
<td>400</td>
<td>1913-2475</td>
<td>2500</td>
</tr>
</tbody>
</table>
Ex-ground trees table

<table>
<thead>
<tr>
<th>Size index</th>
<th>Minimum rootball diameter (mm)</th>
<th>Size index</th>
<th>Minimum rootball diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36–55</td>
<td>350</td>
<td>341–383</td>
<td>850</td>
</tr>
<tr>
<td>56–72</td>
<td>400</td>
<td>384–429</td>
<td>900</td>
</tr>
<tr>
<td>73–106</td>
<td>450</td>
<td>430–530</td>
<td>1000</td>
</tr>
<tr>
<td>107–131</td>
<td>500</td>
<td>531–642</td>
<td>1100</td>
</tr>
<tr>
<td>132–156</td>
<td>550</td>
<td>643–732</td>
<td>1200</td>
</tr>
<tr>
<td>157–173</td>
<td>600</td>
<td>733–859</td>
<td>1300</td>
</tr>
<tr>
<td>174–228</td>
<td>650</td>
<td>860–1144</td>
<td>1500</td>
</tr>
<tr>
<td>229–249</td>
<td>700</td>
<td>1145–1507</td>
<td>1750</td>
</tr>
<tr>
<td>250–299</td>
<td>750</td>
<td>1508–1968</td>
<td>2000</td>
</tr>
<tr>
<td>300–340</td>
<td>800</td>
<td>1969–3075</td>
<td>2500</td>
</tr>
</tbody>
</table>

Trees outside the ranges shown in the Common container volumes table and the Ex-ground trees table:

- Height: [complete/delete]
- Calliper: [complete/delete]
- Rootball volume: [complete/delete]

Photographs: Provide current colour copies with date verification.

3.7 ABOVE-GROUND QUALITIES

Supply
General: Supply only trees that:
- Are free from injury.
- Are self-supporting.
- Have the calliper at any given point on the stem greater than the calliper at any higher point on the stem.

Pruning
- Specific form: [complete/delete]

Clean stem height: less than 40% of total tree height.

Pruning wounds
- Extent: Restrict fresh (i.e. recent, non-calloused pruning wounds) to < 20% of total tree height.
- Type: Ensure a clean-cut at the branch collar.
- Diameter of wound: less than 50% of the calliper immediately above the point of pruning.

Apical dominance
Species with an excurrent form: Defined central leader and intact apical bud.

Crown symmetry
Crown distribution: Difference on opposite sides of the stem axis < 20%.

Stem structure
Species with excurrent form: Single stem roughly in the centre of the tree with any deviation from vertical less than 15°.
Species with decurrent form: Central stem undivided below the clean stem height nominated with sound stem junction at the point of division.
All species: Branch diameter less than or equal to one-half of the calliper immediately above the branch junction.

Included bark
General: Convex branch/stem bark ridges at junctions between stems and branches and between co-dominant stems.
- Exception: [complete/delete]

Trunk position
Variation in distance from the centre of the trunk to the extremity of the rootball: no more than 10%.
Compatibility of graft unions
Union between the scion and rootstock: Sound for the perimeter of the graft.
Diameter of the scion immediately above the graft: Equal to the diameter of the rootstock immediately below the graft (± 20%).

Indication of north
Trees in containers greater than 100 L or of size index greater than 140: Indicate the northerly aspect during growth in the nursery.
General: Indicator to withstand transit without erasure or misplacement.

3.8 STREET TREES – BELOW-GROUND QUALITIES

Root division
Trees in containers less than or equal to 45 L or ex-ground trees with a size index less than or equal to 70: Primary division of roots at less than 100 mm intervals.
Trees in containers greater than 45 L or ex-ground trees with a size index greater than 70: Primary division of roots within the outer 50% of the rootball at less than 100 mm intervals.

Root direction
General: Ensure that roots generally grow in an outwards (radial) or downwards direction from the point of initiation and that any deviation from the established direction is less than 45º.
Trees with a calliper at ground level less than 40 mm: Ensure the diameter of any nonconforming roots at the extremity of the rootball is less than 25% of the calliper.
Trees with a calliper at ground level of 40 mm or larger: Ensure the diameter of any nonconforming roots at the extremity of the rootball is less than 10 mm.

Rootball occupancy
Soil retention: On shaking or handling the unsupported rootball, at least 90% of the soil volume to remain intact.

Rootball depth
Rootball depth assessment for containers/rootballs 45 L or larger:
- Depth: no greater than maximum depth documented.
- Maximum depth (regardless of size): 550 mm.
- Diameter: Greater than or equal to depth.

Height of root crown
General: Ensure that root crown is at the surface of the rootball.

Non-suckering rootstock
Grafted cultivars/varieties: Supply trees grafted onto non-suckering rootstock.

4 EXECUTION

4.1 SLOPES AND DRAINS

Program
Between September and May: Vegetate exposed surfaces before the area exceeds 1 ha.
Between June and August: Do not carry out landscape work to exposed surfaces without approval.

Preparation
Herbicide treatment:
- Spray application
  - Rate: To Annexure A.
  - Program: Maintain sprayed areas undisturbed for 2 weeks. This is a WITNESS POINT.
Soil conditioning:
- Material and rate: To Annexure A.
- Gypsum application: Acceptable methods:
  Spread evenly over the subsoil by a mechanical spreader and topsoil on the same day.
  Thoroughly mixed into the topsoil whilst the topsoil is being removed from stockpiles.
  - Apply conditioners other than gypsum to the supplier’s recommendations and as approved by the Superintendent.
Seed mixing:
- Notice prior to sowing: 2 days. This is a WITNESS POINT.
- Mix, pre-treat and place seed in the sowing equipment for each operation on site.
- Sow seed on the day of mixing with pesticide.

**Watering**

Application:
- Initial watering: To a uniform moisture condition without run-off.
- After sowing: Re-water to a uniform moisture condition without causing rills in the surface, daily for 15 days or as directed.

Excessive rilling: If excessive rilling has occurred, as determined by the Superintendent, re-prepare and re-sow the affected area. This is a **WITNESS POINT**.

**4.2 SLOPES 3H TO 1V OR FLATTER**

**Preparation of the surface**

Cultivation: Before topsoiling, tyne to a depth of 200 mm to produce a loose surface and remove all large stones, rubbish and other materials that may hinder germination.

**Topsoil**

Approval from the Superintendent: Required.

Application: Apply uniformly to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.

Cultivation depth: 50 mm, to provide a roughened surface with soil lumps not exceeding 50 mm.

**Incorporation of pesticide**

Timing: Immediately before sowing.

Pesticide type: Powder form.

Application: Mix thoroughly with the seed at the rate specified in [Annexure A](#), to the equivalent mass of seed to be spread on 1 hectare of the surface in accordance with [Annexure A](#).

**Grassing**

Sowing:
- Application: Distribute evenly by a mechanical seeder following the finished contours wherever possible.
- Depth: 5 mm as sown or 5 mm cover by raking or harrowing.
- Fertiliser: Apply concurrently with seeding to [Annexure A](#).

Turfing:
- Laying: On the prepared topsoiled surface.
- Runs of turf: Butt hard against each other and be place perpendicular to the direction of water flow.
- Slopes 5:1 to 3:1: Peg turfs and remove pegs when established.

Seams: Topdress with topsoil.

Topdressing:
- Timing: 4 to 6 weeks after laying turf.
- Requirement: Correct any undulations or unevenness in the established turf.

Maximum slope for areas to be maintained by a ride-on mower with a 2 m wide deck: 4:1.

**4.3 SLOPES STEEPER THAN 3H TO 1V**

**Methods**

Vegetate slopes by one of the following methods:
- Topsoiling and hydromulching.
- Topsoiling, hydroseeding and straw mulching.
- Hydroseeding.

Determination of method: If not shown on drawings, by the Superintendent.

**Preparation of the surface**

General: Remove all loose material from fill batters and cut batters.

Timing: No more than seven days before seeding.

Method:
- If batters are not stepped: By dragging a steel chain of 30 kg/m minimum weight.
- Elsewhere: As approved by the Superintendent.
Topsoil
Application:
- Stepped batters: Loosely fill with topsoil.
- Elsewhere: Apply uniformly to provide an average thickness of 50 mm with a minimum compacted thickness of 30 mm.

Hydromulching or hydroseeding
Application rate: To the Hydromulching or hydroseeding table.
Watering: Water dry surfaces by a fine spray before the application of the hydromulch.
Pesticide:
- Timing: Apply during preparation of the hydromulch or hydroseed slurry.
- Pesticide type: Liquid, added to the slurry storage tank.
- Rate: 5 litres of pesticide to the equivalent volume of hydromulch or hydroseed slurry to be spread on 1 hectare of surface.

Equipment: Clean and free of contamination from previous operations.
Mix: The addition of the specified materials in the tank and agitated to maintain a uniform consistency during application.
Application: Uniformly over the whole surface.
Weather Conditions: Do not apply Hydromulch or hydroseed under the following weather conditions at the site:
- When temperature is higher than 35°C.
- When winds exceed 15 km/hr.
- Where, in the opinion of the Superintendent, the surface is too wet.
- During rain periods or when rain appears imminent.

<table>
<thead>
<tr>
<th>Material</th>
<th>Application rate per hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hydromulching</td>
</tr>
<tr>
<td>Vegetable mulch (kg)</td>
<td>1500</td>
</tr>
<tr>
<td>Water (L)</td>
<td>35,000</td>
</tr>
<tr>
<td>Binder (L)</td>
<td>1200</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>See Annexure A</td>
</tr>
<tr>
<td>Seed</td>
<td>See Annexure A</td>
</tr>
<tr>
<td>Wetting agent (L)</td>
<td>35</td>
</tr>
<tr>
<td>Pesticide (L)</td>
<td>5</td>
</tr>
</tbody>
</table>

Straw mulching
Application: Apply uniformly by a suitable blower.
Rate: 250 bales (each of 20 kg) of straw per hectare of surface.
Bitumen emulsion: Incorporate as a spray into the air stream of the mulch blower at ≥ 2500 litres per hectare of surface.
Straw mat thickness: ≥ 20 mm at any location.

4.4 OPEN DRAINS

Preparation of the surface
Topsoil: Spread to provide an average compacted thickness of 50 mm with a minimum compacted thickness of 30 mm at any location.
Timing: Complete vegetation within 7 days of the completion of open drain excavation.

Sowing
Rate: To Annexure A.
Application: Apply uniformly by one of the following procedures as directed by the Superintendent:
- Mechanical sowing.
- Hydromulching or hydroseeding.
- By hand.

Surface protection
Provide protection to all or part of the sown surface by one of the following methods:
- Bitumen emulsion: Spray the surface with an anionic slow setting bitumen emulsion to Grade ASS of AS 1160 at a rate of 1 litre of bitumen emulsion per square metre of surface.

- Organic fibre mat: Line the channel with an organic fibre mat listed in Annexure A. Lay the runs of matting along the direction of water flow loosely on the soil surface and not stretched. Slot the upstream end of the matting into a trench 150 mm wide by 150 mm deep and pinned to the base of the trench at 200 mm centres. Backfill the trench with soil and compact by foot. Provide ‘U’ shaped pins of 4 mm gauge wire, 50 mm wide and 150 mm long legs. Overlap adjacent runs of matting 100 mm with the higher run lapped over the lower run. Pin the matting along the sides of each run at 500 mm centres and along the middle of each run at 1000 mm centres. Provide end overlaps 150 mm wide with the higher run end lapped over the start of the lower run and pinned at 200 mm centres.

- Turfing: Butt runs of turf hard against each other and placed perpendicular to the direction of water flow in the drain. Pin into position at 500 mm centres. Topdress seams of turf with topsoil.

Determination of method: If not shown on drawings, by the Superintendent.

4.5 LANDSCAPE PLANTING

Conditions
Timing: Give minimum 2 days notice of commencement of planting.
Conditions: Do not carry out landscape planting in extreme weather conditions (above 35°C or below 10°C), unless otherwise approved by the Superintendent.

Preparation generally
Weed management by herbicide spray:
- Rate: To Annexure A.
- Program: Maintain sprayed areas undisturbed for 2 weeks.
- Spray drift: Ensure there is no contact with planted material.

Alternative weed management by synthetic weed blocking fabric:
- Extent: 800 mm surrounding each proposed planting.
- Approval: Required.

Soil conditioning:
- Material and rate: To Annexure A.
- Gypsum application: Acceptable methods:
  Spread evenly over the subsoil by a mechanical spreader and topsoiled on the same day. Thoroughly mixed into the topsoil whilst the topsoil is being removed from stockpiles.
- Other conditioners: Apply to the supplier’s recommendations and as approved.

Mass planting in mulched bed
Surface preparation: Rip the surface at 500 mm centres to a depth of 300 mm and break up the top 200 mm of the planting bed by cultivation to a maximum size of 50 mm.
Mulch: Spread 75 mm thick.

Individual planting
Preparation: Loosen a planting area 600 mm diameter to a depth of 400 mm.
Mulch: Spread 75 mm thick to 600 mm radius around the plant.

Planting – minor works
This clause is for minor works such as mass planted areas associated with cut and fill batters, pathway verges, median areas and open drains.
Method: Remove the localised mulch. Root prune to ensure all circling roots have been either severed or aligned radially into the surrounding soil. Place the plant, backfill the planting hole with topsoil and compact lightly so as to minimise subsidence without compacting the backfill. Avoid mixing mulch with topsoil.
Stakes and ties: ‘Advanced’ and ‘super advanced’ stock:
- Drive stakes 300 mm deep and 200 mm clear of the plant.
- Ties: 50 mm wide hessian webbing strips, attached loosely.
Watering: 10 litres of water per hole before the mulch is respread over the disturbed area.
Mulching: Replace, and leave the plant stem clear.

Landscape planting - major works
If the project is of a major scope the following procedure should be followed:
Care of landscape planting – minor works

This clause is for minor works such as mass planted areas associated with cut and fill batters, pathway verges, median areas and open drains.

Watering: Water all plants, from the time of planting, at the rate of 10 litres per plant every third day for the first twelve weeks.

Replacement: Replace missing plants, dead plants and plants nominated by the Superintendent as unhealthy with plants of similar size and quality and of identical species and variety to the plant being replaced.

Weed and grass growth in mulched areas: Control with herbicide, in accordance with the manufacturer’s instructions at monthly intervals during the construction period and contract maintenance period. Replace plants damaged by herbicide application.

Landscape planting – major works

If the project is of a major scope the following procedure should be followed:

4.6 STREET TREES

Unpaved areas

Excavation:
- Containers < 75 litre: Twice the diameter of the root ball.
- Containers ≥ 75 litre: three times the diameter of the root ball.
- Depth: Root ball plus 100 mm. Loosen the compacted sides, and the bottom a further 100 mm.

Planting: If clay is present add 1 kg of agricultural gypsum soil conditioning.

Accessories and drainage: Fit trunk collar guard, root barrier and subsoil drainage measures prior to backfilling.

Backfill: Topsoil.

Mulch: 75 mm thick and 50 mm clear of plant stem.

Initial watering: 50 litres per tree applied in stages during backfilling.

Paved areas

Excavation for structural soil: [complete/delete]

Select a cubic capacity to suit the size and species of the tree. A potentially large tree may need 12 m³.

Accessories and drainage: Fit trunk collar guard, root barrier and subsoil drainage measures prior to backfilling.

Backfill: Provide structural soil to the Structural soil table.

---

Structural soil table

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Fertiliser</th>
<th>Depth</th>
</tr>
</thead>
</table>
| Structural soil 20 mm | 75% 20 mm crushed river gravel
25% filler soil of 1 part screeded dolomite to 1 part screeded sandy loam | Trace element mix: 300 g/m³
Potassium nitrate: 500 g/m³
Ammonium nitrate: 500 g/m³
Superphosphate: 500 g/m³
Ion sulphate: 1.5 kg/m³
8/9 month Controlled Release: 2 kg/m³
Gypsum: 500 g/m³
Magnesium sulphate: 400 g/m³
Magriline: 600 g/m³ | 100 mm |
| Structural soil 40 mm | 80% 40 mm basalt aggregate
20% filler soil of 1 part screeded dolomite to 1 part screeded sandy loam | Trace element mix: 300 g/m³
Potassium nitrate: 500 g/m³
Ammonium nitrate: 500 g/m³
Superphosphate: 500 g/m³
Ion sulphate: 1.5 kg/m³
8/9 month Controlled Release: 2 kg/m³
Gypsum: 500 g/m³
Magnesium sulphate: 400 g/m³
Magriline: 600 g/m³ | Varies |

---

Structural soil type: [complete/delete]

Mulch: 10 mm screenings 75 mm thick.

Initial watering: 50 litres per tree applied gradually.
Porous bonded gravel
Backfill: Allow for base aggregate and gravel.
Filter fabric: Lay over growing medium pre cut to size.
Base aggregate: 5 to 7 mm crushed blue metal laid 70 mm deep and hand consolidated.
Porous paving: Mix and place to the manufacturers published directions.

4.7 TRANSPLANTING STREET TREES

General
General: Conform to the Transplanting schedule.
Notice: Give notice prior to:
Watering: [complete/delete]
Fertilising: [complete/delete]
Root cutting: [complete/delete]

This is a WITNESS POINT.

Conditions: Select a time for transplanting having regard to the appropriate season, time of actual operation, rootball diameter and depth, lifting methods, weather conditions and the like.

Preparation
Watering: Establish a temporary trickle irrigation system, or manually water the intended trees for a period of two weeks prior to ball excavation work.
Fertilising: Apply one application of liquid fertiliser mix to the foliage and root as appropriate to the species. Apply sufficient liquid fertiliser mix to allow the spray to drip from foliage and soak into the rootball. Do not spray the fertiliser mix on excessively hot, dry or windy days.

Rootball
General: Minimise the cutting of roots. Use only sharp tools, water blasting or water cutting.
Initial cut:
- Manually or by chain trenching machine. Trees whose rootballs have been excavated by backhoe or excavator are not acceptable.
- Located 250 mm beyond the required finished rootball dimensions of each side to allow any damaged roots to be trimmed back to final dimensions and sealed.
Hand trimming:
- To 100 mm less than the required finished rootball dimension. Cut back and seal with an approved horticultural sealer on all roots greater than 25 mm diameter.

Outcome: Cut rootball to be:
- Symmetrical about the trunk and in proportion to the overall size of the tree except where the limitations of individual tree planter openings requires specific tailoring of the rootball dimension.
- Cut to a size designed to maximise the rootball in the best interests of each specimen.

Trench: Backfill and lightly compact with clean sand, free of any foreign matter, pathogens or any substances likely to be deleterious to future root growth. Apply sufficient root inducing formulation, at the manufacturer's recommended concentration, to effectively saturate the backfill in the trench.

Maintenance of on-site plant material
Watering: Maintain a trickle irrigation system around each tree, located within the trenched rootball perimeter. Program the system to supply water at an optimum rate to encourage healthy growth and avoid desiccation through excessive transpiration following the pruning of the roots. Monitor the system until the tree is lifted and transplanted.
Fertilising: Submit a program for regular fertiliser applications continued over this period. This is a WITNESS POINT.
Responsibility: Take precautions to safeguard the health and well being of all on site plant material prior to the lifting and transplanting.

Above ground
Pruning: If selected pruning of branches appears necessary to balance root loss obtain prior approval. This is a WITNESS POINT.
Lifting: Thoroughly irrigate to the full depth of the rootball two days prior to transplanting of each specimen. Do not fracture the ball of soil around the root system. Maintain ball in firm condition.
during transplanting by wrapping in hessian or other appropriate open weave material, securely tied.
Storage: Transport transplanted trees to a designated nursery site. Store and maintain until ready for planting.
Planting: Avoid disturbance to the rootball during moving and planting. After placement, remove the rootball wrapping and ties by cutting.
Watering: At the completion of transplanting, water the rootball thoroughly and continue to water until established.

4.8 LIMITS AND TOLERANCES

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

Limits and tolerances table

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/tolerances</th>
<th>Worksection reference Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topsoil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Organic content</td>
<td>&gt; 3% by mass</td>
<td>MATERIALS/Topsoil – minor works</td>
</tr>
<tr>
<td>- pH</td>
<td>&gt; 5.5 &lt; 7.5</td>
<td></td>
</tr>
<tr>
<td>- Soluble Salt</td>
<td>&lt; 0.06% by mass</td>
<td></td>
</tr>
<tr>
<td>Turf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Width of rolls</td>
<td>&gt; 300 mm</td>
<td>MATERIALS/Plant material (Turf)</td>
</tr>
<tr>
<td>Vegetable Mulch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Hydromulch</td>
<td>Maximum size &lt; 10 mm</td>
<td>MATERIALS/Fertiliser and mulches</td>
</tr>
<tr>
<td>- Paper pulp</td>
<td>&lt; 50% by mass of total mulch</td>
<td></td>
</tr>
<tr>
<td>Straw mulching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Straw mat</td>
<td>Finished thickness &gt; 20 mm</td>
<td>MATERIALS/Fertiliser and mulches</td>
</tr>
<tr>
<td>Mulch composition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Fines</td>
<td>&lt; 5% by volume</td>
<td>MATERIALS/Fertiliser and mulches</td>
</tr>
<tr>
<td>- Woodchip</td>
<td>Maximum size &lt; 50 mm</td>
<td></td>
</tr>
<tr>
<td>- Leaf mulch</td>
<td>&lt; 25% by volume</td>
<td></td>
</tr>
<tr>
<td>Plant material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Container soil mix</td>
<td>Contain 20% to 25% by volume of clay</td>
<td>Plant materials</td>
</tr>
<tr>
<td>Topsoil (Execution)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Temperature</td>
<td>Minimum compacted thickness at any location of 30 mm</td>
<td>EXECUTION/Slopes 3:1 or flatter, Slopes steeper than 3:1</td>
</tr>
<tr>
<td>Landscape planting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Temperature</td>
<td>Planting not to be undertaken when temperatures &gt; 35°C or &lt; 10°C.</td>
<td>EXECUTION/Landscape planting (Conditions)</td>
</tr>
</tbody>
</table>

Location of planting
General: Do not obstruct access to services or sightlines to signage. Do not obstruct pedestrian or vehicular traffic.

Street trees
Ground clearance:
- Clearance height at maturity: 2.4 m.
- Clearance height at time of planting: 1.5 m.
Setbacks:
- Mature canopy clearance: Locate trees to achieve clearances from the following:
  Electricity or telecommunications poles or pillars: > 4 m.
  Streetlights: > 7.5 m.
  High voltage transmission lines: > 4 m radius.
  Stormwater drainage pits: > 2 m.
  Kerbs: 750 mm to 1000 mm measured to the back of the kerb.
Driveways: > 3 m.
Intersections: > 10 m measured from the face of the kerb of the adjoining street.
Existing trees: The combined mature canopy width.

**Roundabouts**
Setback: From the inside edge of the kerb as follows:
- 0 – 1 m: Appropriate pavement material.
- 1 – 3 m: Shrubs/groundcovers with a maximum mature unpruned height of 600 mm above the road pavement.
- 3 m and over: Trees and shrubs/groundcovers.

**Median Islands**
Setback: From the inside edge of the kerb as follows:
0 m – 0.3 m: Appropriate pavement material.
0.3 m – 1 m: Appropriate groundcovers, 200 mm high with minimal pruning requirements.

## 5 MEASUREMENT AND PAYMENT

### 5.1 MEASUREMENT

**General**
Payment to the schedule of rates: To 0152 Schedule of rates – projects, worksection 0257 Landscape: – roadways and street trees, the drawings and Pay items 0257.1 to 0257.5.
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:
- All areas of landscape works: In the plane of the surface.
- Thickness: Applied perpendicular to the surface.
- Erosion and sedimentation control measures: To 1102 Control of erosion and sedimentation.
- Topsoil stockpiling: To 1112 Earthworks (Roadways).
### 5.2 PAY ITEMS

This clause assumes the contract is tendered on the basis of a Schedule of Rates as appropriate for minimal documentation of landscaped areas.

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule Rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>0257.1 Vegetation of slopes 3 to 1 or flatter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0257.1(1) Vegetation—Seeding</td>
<td>m²</td>
<td>All costs associated with the vegetation of slopes by seeding other than the cost of watering, and supply of imported topsoil.</td>
</tr>
<tr>
<td>0257.1(2) Vegetation—Turfing</td>
<td>m²</td>
<td>All costs associated with the vegetation of such slopes by turfing other than the cost of watering, and supply of imported topsoil.</td>
</tr>
<tr>
<td>0257.1(3) Watering</td>
<td>Kilolitre</td>
<td>All costs associated with supply and delivery of the water and the watering of the seeded and/or turfed areas.</td>
</tr>
</tbody>
</table>

| 0257.2 Vegetation of slopes steeper than 3 to 1 |  |  |
| 0257.2(1) Preparation of surface other than stepped batters | m² | All costs associated with the preparation of the surface for vegetation other than the cost of supply of imported topsoil. |
| 0257.2(2) Preparation of surface of stepped batters | m² on the batter slope | All costs associated with the preparation of the batter slope for vegetation other than the cost of supply of imported topsoil. |
| 0257.2(3) Hydromulching | m² | All costs associated with hydromulching other than the watering of dry surfaces. |
| 0257.2(4) Hydroseeding | m² | All costs associated with hydroseeding other than the watering of dry surfaces. |
| 0257.2(5) Straw Mulching | m² | All costs associated with straw mulching. |
| 0257.2(6) Watering | Kilolitre | All costs associated with supply and delivery of the water and the watering of dry surfaces. |

<p>| 0257.3 Vegetation of open drains |  |  |
| 0257.3(1) Preparation and Topsoiling of Drains | m² | All costs associated with preparation of the surface for sowing. |
| 0257.3(2) Mechanical Sowing | m² | All costs associated with sowing and fertilizing. |
| 0257.3(3) Hydromulching | m² | All costs associated with hydromulching other than the watering of dry surfaces. |
| 0257.3(4) Hydroseeding | m² | All costs associated with hydroseeding other than the watering of dry surfaces. |
| 0257.3(5) Hand Sowing | m² | All costs associated with sowing by hand. |
| 0257.3(6) Spray with bitumen | m² | All costs associated with the |</p>
<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule Rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>emulsion</td>
<td></td>
<td>supply and spraying of bitumen emulsion.</td>
</tr>
<tr>
<td>0257.3(7) Lining with organic fibre mat</td>
<td>m²</td>
<td>All costs associated with the supply and placement of organic fibre mat.</td>
</tr>
<tr>
<td>0257.3(8) Turfing</td>
<td>m²</td>
<td>All costs associated with the supply and placement of turf.</td>
</tr>
<tr>
<td>0257.3(9) Watering</td>
<td>Kilolitre</td>
<td>All costs associated with supply and delivery of the water and the watering of dry surfaces and all treated drain areas.</td>
</tr>
<tr>
<td>Determination of volume: By calibrated dipstick readings or other method approved by the Superintendent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0257.4 Landscape planting</td>
<td></td>
<td>All costs associated with the preparatory work of the mulched bed before planting.</td>
</tr>
<tr>
<td>0257.4(1) Provision of mulched bed for mass planting</td>
<td>m²</td>
<td>All costs associated with the planting in the mulched bed and subsequent care of each plant.</td>
</tr>
<tr>
<td>0257.4(2) Mass planting</td>
<td>Each plant</td>
<td>All costs associated with the planting in the mulched bed and subsequent care of each plant.</td>
</tr>
<tr>
<td>0257.4(3) Individual Landscape Planting of Stock</td>
<td>Each plant</td>
<td>All costs associated with the preparatory work, planting and subsequent care of each plant.</td>
</tr>
<tr>
<td>0257.5 Supply of imported topsoil</td>
<td></td>
<td>All costs associated with the supply and delivery of the topsoil to the site as directed by the Superintendent. Placing and spreading of the topsoil is excluded from this pay item and is included in the specific activity pay items for vegetation or planting as appropriate.</td>
</tr>
<tr>
<td>General</td>
<td>The cubic metre measured loose in the truck as delivered</td>
<td>All costs associated with the supply and delivery of the topsoil to the site as directed by the Superintendent. Placing and spreading of the topsoil is excluded from this pay item and is included in the specific activity pay items for vegetation or planting as appropriate.</td>
</tr>
</tbody>
</table>
6 ANNEXURE A

6.1 LANDSCAPING MATERIALS

_Edit with additions or deletions to suit the project._

**Landscaping materials**

<table>
<thead>
<tr>
<th>Material</th>
<th>Type</th>
<th>Minimum application rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Herbicide*</td>
<td>Glyphosate e.g. Roundup</td>
<td>9 litres/200 litres water/ha</td>
</tr>
<tr>
<td>2. Seed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Grass</td>
<td>Rye Corn (April-August) or</td>
<td>60 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Japanese Millet (September-March)</td>
<td>60 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Hullied Couch</td>
<td>5 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Red Clover (Inoculated)</td>
<td>5 kg/ha</td>
</tr>
<tr>
<td></td>
<td>White Clover (Inoculated)</td>
<td>5 kg/ha</td>
</tr>
<tr>
<td></td>
<td>‘Elka’ Perennial Rye</td>
<td>5 kg/ha</td>
</tr>
<tr>
<td>- Native</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acacia dealbata</td>
<td>4 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Acacia buxifolia</td>
<td>1 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Acacia decurrens</td>
<td>1 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Acacia pravissima</td>
<td>1 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Leptospermum lanigerum</td>
<td>1 kg/ha</td>
</tr>
<tr>
<td></td>
<td>Hardenbergia violacea</td>
<td>500 g/ha</td>
</tr>
<tr>
<td></td>
<td>Kennedia prostrata</td>
<td>500 g/ha</td>
</tr>
<tr>
<td></td>
<td>Acacia implexa</td>
<td>200 g/ha</td>
</tr>
<tr>
<td></td>
<td>Banksia marginata</td>
<td>200 g/ha</td>
</tr>
<tr>
<td></td>
<td>Bursaria spinosa</td>
<td>200 g/ha</td>
</tr>
<tr>
<td></td>
<td>Callistemon pallidus</td>
<td>200 g/ha</td>
</tr>
<tr>
<td></td>
<td>Dodonaeviscoca</td>
<td>200 g/ha</td>
</tr>
<tr>
<td>3. Turf grass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Medians</td>
<td>Couch</td>
<td>Refer to Drawings</td>
</tr>
<tr>
<td>- Verges/Footpaths</td>
<td>Buffalo</td>
<td></td>
</tr>
<tr>
<td>- Other Areas</td>
<td>Couch</td>
<td></td>
</tr>
<tr>
<td>4. Fertiliser *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation of Slopes/Drains</td>
<td>Dynamic Lifter ‘Nitro’</td>
<td>1000 kg/ha</td>
</tr>
<tr>
<td>5. WETTING AGENT *</td>
<td>‘Aquasoil’</td>
<td>1 litre/1000 litres of mix water</td>
</tr>
<tr>
<td>6. PESTICIDE *</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid Powder</td>
<td>‘Lorsban 500 EC’</td>
<td>5 litres</td>
</tr>
<tr>
<td></td>
<td>‘Lorsban 250 W’</td>
<td>10 kg</td>
</tr>
<tr>
<td>7. SOIL CONDITIONER*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetation of Slopes/Drains</td>
<td>Gypsum</td>
<td>400 g/m²</td>
</tr>
<tr>
<td>Landscape Planting</td>
<td>N:P:K ratio 6.3:1.8:2.8</td>
<td>5k g/m²</td>
</tr>
<tr>
<td>8. ORGANIC FIBRE MAT*</td>
<td>‘Sta-firma’ (light grade)</td>
<td>—</td>
</tr>
<tr>
<td>9. MULCH</td>
<td>Composted/Pasteurized</td>
<td>75 mm thick</td>
</tr>
</tbody>
</table>

* Provide the material as listed or as approved by the local authority.
6.2 PLANT MATERIAL

Plant material supply schedule

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Common name</th>
<th>Size</th>
<th>Quantity (+10%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Plant selection: Consult the Local Authority for the list of recommended (or proscribed) species.

Transplanting schedule

<table>
<thead>
<tr>
<th>Species</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Specimen plants schedule

<table>
<thead>
<tr>
<th>Species</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
0281 BUSHFIRE PERIMETER TRACKS

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
Bushfire protection: Construct bushfire perimeter tracks as documented and make sure that the work is undertaken to minimise the disturbance of the natural surroundings and the need for future maintenance.

Performance
Requirements: [complete/delete]

Design
Designer: [complete/delete]

1.2 CROSS REFERENCES

General
- Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0257 Landscape - roadways and street trees.
- 1351 Stormwater drainage (Construction).
- 1352 Pipe drainage.
- 1353 Precast box culverts.
- 1354 Drainage structures.

1.3 REFERENCED DOCUMENTS

Standards
General: The following document is incorporated into this worksection by reference:
NSW Soil Conservation Act, 1938.

1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the definitions given below apply:
- Batter: The face of an embankment or cutting, produced as a result of earthmoving operations involving cutting and filling.
- Borrow area: An area or excavation from which soil, clay, sand, rock or gravel has been excavated for a specific purpose.
- Perimeter access tracks: Provide maintained access for fire fighting beyond private lots.
- Cross bank: A hump of earth constructed across a track so that runoff is effectively diverted from it. Cross banks are designed to handle larger flows than cross drains.
- Cross drains: Drains of various forms that hinder the flow of water down a track and divert it across the track’s surface. The capacity of the drain is defined by its cross-section. Cross drains are designed to handle smaller flows than cross banks but larger flows than can be controlled by crossfall drainage.
- Crossfall drainage: Drainage which occurs when the surface of a track has sufficient cross slope to cause water to flow across and off the surface, rather than along it. Where the water flows into the hillside, it is termed ‘infall’. Where flow is away from the hillside, it is termed ‘outfall’.
- Culvert: A pipe or similar structure used to direct water under the track.
- Erosion classes in relation to soil types:
  - Class A: Low soil erodibility. Brown and red soils derived from finer sediments and metasediments.
  - Class B: High soil erodibility. Red soils on fine granites, fine sandstones and basalt.
  - Class C: Very high soil erodibility. Grey and yellow soils derived from granites, sediment and metasediment, especially coarse grained types.
  - Class D: Extreme soil erodibility. Unconsolidated sediment. As a general rule, tracks should not be built on Class D soils.

2 PRE-CONSTRUCTION PLANNING

2.1 GENERAL

Quality
Requirements: Conform to 0161 Quality (Construction) for quality control and testing, including maximum lot sizes and minimum test frequencies.

Connection to existing tracks
Connection: Connect perimeter tracks with the subdivision by suitable intersections with existing access tracks.

Reducing erosion and maintenance
Erosion: Construct the track surface with outfall drainage and trafficable cross banks, so as to reduce erosion damage and maintenance needs.
Maintenance: Further reduce the risk of erosion by establishing and maintaining vegetation on the tracks in designated areas. The vegetation on fire access tracks should be suitable low grasses and ground covers, less than 0.3 m high.

3 EXECUTION

3.1 EARTHWORKS

Minimum disturbance
General: Construct tracks with as little disturbance as possible to the soil and vegetation both on and adjacent to the track. Follow the contour of the land as much as possible to reduce the amount of cut and fill.
Safety: Provide maximum crossfall < 1:10 (horizontal:vertical).

Cut batters
General: Construct cut batters as follows:
- Vertically to 1.5 m: Minimise the area of disturbed soil exposed.
- Higher than 1.5 m: Provide special stabilisation measures including laying back, revegetation and drainage.
- Dispersive soils: If encountered give notice.

Fill batters
General: Construct fill batters as follows:
- As flat as possible to encourage natural revegetation and to effectively accept seed and fertiliser.
- On all soil classes not be steeper than 2:1 (horizontal:vertical).
Batters higher than 1.5 m on Class B, C and D soils: Provide special stabilisation works, such as drop down drains or hay mulching.
- Give notice if dispersive soils are encountered.
Fill batters: Do not use vegetation debris or erosive materials.

Borrow areas
Location: Do not locate borrow areas near drainage lines or streams in order to avoid sediment polluting the stream. Limit ‘borrow’ areas in size and work in such a way as to reduce the amount of sediment leaving the borrow pit, and revegetate progressively as the pit is worked out.

Stockpile topsoil
General: Stockpile wherever practicable, topsoil and litter (free of timber debris) in a recoverable location for respreading over disturbed areas.
Timber clearing
Clearing: Limit to 0.5 m on either side of the track, and include overhanging branches to 4 m clear height.
Method: Clear by felling rather than dozing to limit the amount of soil disturbance.
Waste: Dispose of all vegetation matter off site.

3.2 CROSS BANKS

Cross bank outlet points
Blockage: Do not block the outlet points for cross banks with stumps or rocks.
Runoff: Site the outlets such that the runoff spills into undisturbed vegetation and cannot flow back onto the track.

Construction
Method: Rip the roadway area to a depth of 200 to 300 mm for a distance of one or two tractor lengths back from the chosen outlet point. Push the loose earth down the roadline into a bank, commencing at the uphill side of the road and working across the outlet side. Provide a long, shallow excavation for the cross bank.
Cross bank length: 6 m.

Shaping and compaction
Dimension: Use sufficient loose earth to give the required dimensions after shaping and compaction. Size the crest width to ensure comfortable vehicle access over the cross bank, and the channel depth to prevent runoff from overtopping the bank.
Compaction: Track or wheel roll the entire length of the bank to obtain maximum compaction and a smooth, even bank with batters no steeper than 1:5 (horizontal:vertical) in relation to the track surface.

3.3 DRAINAGE

Crossings
General: Construct fords, culverts or bridges across drainage lines and streams, as documented.
Prohibition: Do not use log dam crossings as they obstruct flood flows and can create turbulent flow and erosion.

Fords
General: Construct fords as documented or as directed by the Superintendent.

Culverts
Construction: Construct culverts and headwalls as documented or as directed by the Superintendent in accordance with 1351 Stormwater drainage (Construction), 1352 Pipe drainage, 1353 Precast box culverts and 1354 Drainage structures.
Alignment: Construct culverts as close as possible to the natural alignment of the drainage line to avoid diverting the flow into the stream banks or creating scour along the drainage line.
Prohibition: Do not use culverts where debris or blockages are likely.

Disturbance
General: Keep soil and vegetation disturbance to a minimum. Seed disturbed areas in accordance with 0257 Landscape – roadways and street trees to protect them from erosion.
Dumping: Do not dump timber, scrub, soil or debris in drainage lines. Stack well above flood levels.

Trees in prescribed streams
Requirement: Where trees must be removed or may be injured in the bed or within 20 m of the banks of prescribed streams, as defined in the NSW Soil Conservation Act, 1938, an authority from the Catchment Areas Protection Board is required.

3.4 REVEGETATION

Built up areas
General: Provide revegetation in accordance with requirements of 0257 Landscape – roadways and street trees indicated on the development/subdivision plan.

Immediate application
Application: Apply revegetation immediately following the disturbance while the soil is still loose, irrespective of the growing season. Also apply a maintenance dressing of appropriate fertiliser and seed.
4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

General
Payment to the schedule of rates: To 0152 Schedule of rates – Supply projects, 0281 – Bushfire protection and Pay item 0281.1.
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
Methodology for measurement and payment:
- Culverts and headwalls: To 1351 Stormwater drainage (Construction), 1352 Pipe drainage, 1353 Precast box culverts and 1354 Drainage structures, as appropriate.
- Seeding and vegetation: To 0257 Landscape – roadways and street trees.

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>0281.1 Perimeter tracks</td>
<td>Linear metre measured along the centreline of track, as documented.</td>
<td>All activities required to construct the tracks including clearing, earthworks, batters, cross drains, banks and revegetation.</td>
</tr>
</tbody>
</table>
0319 MINOR CONCRETE WORKS

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide cast concrete as documented and as follows:
- In conformance with the design details.
- Which satisfies quality and inspection requirements.
- Compatible with following finishes.

Design
Formwork: The design of the formwork, other than profiled steel sheeting composite formwork is the contractor’s responsibility.

1.2 CROSS REFERENCES

General
- Requirement: Conform to the following:
  - 0136 General requirements (Construction).
  - 0152 Schedule of rates – supply projects.
  - 0161 Quality (Construction).
  - 0165 Buildings and facilities maintenance plan.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS 1012 Methods of testing concrete
AS 1012.3.1-1998 Determination of properties related to the consistency of concrete—Slump test
AS 1012.14-1991 Method for securing and testing cores from hardened concrete for compressive strength
AS 1141 Methods for sampling and testing aggregates
AS 1141.14-2007 Particle shape by proportional calliper
AS 1141.21-1997 Aggregate crushing value
AS 1141.23-2009 Los Angeles value
AS 1141.24-1997 Aggregate soundness—Evaluation by exposure to sodium sulphate solution
AS 1348-2002 Glossary of terms - Roads and traffic engineering
AS 1379-2007 Specification and supply of concrete
AS 1397-2001 Steel sheet and strip - Hot-dipped zinc-coated or aluminium/zinc-coated
AS 1478 Chemical admixtures for concrete, mortar and grout
AS 1478.1-2000 Admixtures for concrete
AS 1554 Structural steel welding
AS 1554.3-2008 Welding of reinforcing steel
AS 2327 Composite structures
AS 2327.1-2003 Simply supported beams
AS 2758 Aggregates and rock for engineering purposes
AS 2758.1-1998 Concrete aggregates
AS 2870-2011 Residential slabs and footings
AS 3600-2009 Concrete structures
AS 3610-1995 Formwork for concrete
AS 3610.1-2010 Documentation and surface finish
AS 3735-2001 Concrete structures retaining liquids
AS 3799-1998 Liquid membrane-forming curing compounds for concrete
AS 3972-2010 General purpose and blended cements
AS/NZS 4586: 2004 Slip resistance classification of new pedestrian surface materials
1.4 STANDARDS

General
Formwork design and construction formed surfaces: To AS 3610 and AS 3610.1.
Plywood formwork: To AS 6669.
Profiled steel sheeting, including shear connectors: To AS 2327.1.
Specification and supply of concrete: To AS 1379.
Concrete materials and construction: To AS 3600.
Concrete structures for retaining liquids: To AS 3735.

Methods and equipment
Precast elements: Comply with the recommendations of NP:PCH.

1.5 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Ambient temperature: The air temperature at the time of mixing and placing of concrete.
- Average ambient temperature: Average value of the daily maximum and minimum ambient temperatures over the relevant period at a site.
- Concrete class:
  - Normal: Concrete which is specified primarily by a standard compressive strength grade and otherwise to conform with AS 1379 clause 1.5.3.
  - Special: Concrete which is specified to have certain properties or characteristics different from, or additional to, those of normal-class concrete and otherwise in conformance with AS 1379 clause 1.5.4.
- Early age strength: A mean compressive strength at 7 days exceeding the values shown in Table 1.2 of AS 1379.
- Green concrete: Concrete which has set but not appreciably hardened.
- Joints:
  - Construction joint: A joint with continuous reinforcement provided to suit construction sequence.
  - Control joint: An unreinforced joint between or within discrete elements of construction which allows for relative movement of the elements.
  - Contraction joint: An opening control joint with a bond breaking coating separating the joint surfaces to allow independent and controlled contraction of different parts or components, induced by shrinkage, temperature changes or other causes. It may include unbound dowels to assist vertical deflection control.
. Expansion joint: A closing control joint with the joint surfaces separated by a compressible filler to allow axial movement due to thermal expansion or contraction with changes in temperature or creep. It may include unbound dowels to assist vertical deflection control.
. Isolation joint: A joint between elements of a structure designed to isolate structural movement while permitting horizontal and/or vertical movement between abutting elements.
. Weakened plane joint: A contraction joint created by forming a groove, extending at least one quarter the depth of the section, either by using a grooving tool, by sawing, or by inserting a premoulded strip.
. Structural control joint: A control joints (contraction, expansion and isolation) in structural elements when used with applied material and finishes.
. Substrate joint: A joint in the substrate which includes construction joints and joints between different materials.
. Sealant joint: A joint filled with a flexible synthetic compound which adheres to surfaces within the joint to prevent the passage of dust, moisture and gases.
- Pavements: The definitions given in AS 1348 apply.
- Sprayed concrete: Concrete pneumatically applied at high velocity on to a surface. Application may be either a wet or dry process, to produce a sound homogeneous product with surface finish reasonably uniform in texture and free from blemishes.
- Weather:
  . Cold: Ambient shade temperature < 10°C.
  . Hot: Ambient shade temperature > 30°C.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.

Construction proposals
Concrete: Submit proposals for mixing, placing, finishing and curing concrete including the following:
- Addition of water at the site.
- Changes to the plastic concrete mix.
- Curing and protection methods.
- Cutting or displacing reinforcement, or cutting hardened concrete.
- Handling, placing, compaction and finishing methods and equipment, including pumping.
- Placing under water.
- Sequence and times for concrete pours, and construction joint locations and relocations.
- Site storage, mixing and transport methods and equipment, if applicable.
- Temperature control methods.

Design
Submit: Shop drawings for cores, fixings, embedded items and precast concrete items.

Materials
Submit: Test results for all materials.

Samples
Submit: Concrete spray test panels.
Execution details: Formwork certificate.

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>PRE-CONSTRUCTION PLANNING</td>
<td></td>
<td></td>
<td></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>Loads on minor concrete structures</td>
<td>Approval for early loading of the structure by design strength in situ tests</td>
<td>3 working days</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Design documentation</td>
<td>Formwork design certificates</td>
<td>3 working days</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Design documentation</td>
<td>Proposed loading schedule</td>
<td>3 working days</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground preparation – Base preparation</td>
<td>Inspect membrane or film underlay installed</td>
<td>1 working day prior to covering</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Ground preparation – Polymeric film</td>
<td>Inspect membrane or film underlay installed</td>
<td>1 working days prior to covering</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Formwork - General</td>
<td>Certification of installed formwork and inspection</td>
<td>1 working day prior to covering</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Steel reinforcement placement – Approval</td>
<td>Inspect reinforcement placement</td>
<td>2 working day prior to covering</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>of reinforcement before concrete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>placement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cores, fixings and embedded items -</td>
<td>Shop drawings for cores, fixings and embedded items</td>
<td>7 working days prior to commencing works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprayed concrete – Method statement</td>
<td>Submit proposal for spraying</td>
<td>14 days prior</td>
<td>Principal Certifying Authority</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>PRE-CONSTRUCTION PLANNING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certificate of compliance</td>
<td>NATA certificates for all materials</td>
<td>7 days prior to commencing on site</td>
</tr>
<tr>
<td>Concrete curing</td>
<td>Certified test results for curing compound</td>
<td>7 days prior</td>
</tr>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground preparation – Mass concrete</td>
<td>Inspect concrete blinding slab</td>
<td>1 working day prior to covering</td>
</tr>
<tr>
<td>bedding on earth foundations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete quality requirements – Formwork</td>
<td>Check erection tolerances</td>
<td>1 working day</td>
</tr>
<tr>
<td>Concrete quality requirements – Surface</td>
<td>Confirm surface quality</td>
<td>1 working day</td>
</tr>
<tr>
<td>quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete quality requirements – Flatness</td>
<td>Confirm unformed surfaces</td>
<td>1 working day</td>
</tr>
<tr>
<td>Formwork – void formers</td>
<td>Test certificates for void formers</td>
<td>Prior to using in the works</td>
</tr>
<tr>
<td>Steel reinforcement placement – Delivery</td>
<td>Submit notice for test inspection</td>
<td>10 working days</td>
</tr>
<tr>
<td>and receipt of reinforcement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel reinforcement</td>
<td>Submit proposed changes to</td>
<td>7 days prior to commencing on</td>
</tr>
<tr>
<td>Clause title/Item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>placement – Placing</td>
<td>reinforcement</td>
<td>site</td>
</tr>
<tr>
<td>Steel reinforcement placement – Damaged galvanizing</td>
<td>Submit proposed repair method</td>
<td>2 working days prior</td>
</tr>
<tr>
<td>Steel reinforcement placement – Provision for concrete placement</td>
<td>Submit proposed changes to spacing, cover, splicing or welding or reinforcement</td>
<td>2 working days prior</td>
</tr>
<tr>
<td>Cores, fixings and embedded items - Cutting or coring</td>
<td>Approval for cutting or coring hardened concrete</td>
<td>2 working days prior</td>
</tr>
<tr>
<td>Mixing of concrete – Consistency</td>
<td>Submit proposal for concrete mixing plan</td>
<td>7 days prior</td>
</tr>
<tr>
<td>Mixing of concrete – Premixed supply</td>
<td>Submit delivery dockets and subcontractors details</td>
<td>Progressive</td>
</tr>
<tr>
<td>Concrete placing and compaction - Placing</td>
<td>Proposed sequence of concrete placement</td>
<td>7 days prior</td>
</tr>
<tr>
<td>Concrete placing and compaction - Concrete placing under water</td>
<td>Submit proposal for placing concrete under water</td>
<td>7 days prior</td>
</tr>
<tr>
<td>Joints - General</td>
<td>Submit proposal for sawn joints</td>
<td>7 days prior</td>
</tr>
<tr>
<td>Formed surfaces - General</td>
<td>Proposed method of surface repair</td>
<td>2 working days prior</td>
</tr>
<tr>
<td>Sprayed concrete – Method statement</td>
<td>Submit proposal for sprayed concrete</td>
<td>14 days</td>
</tr>
<tr>
<td>Sprayed concrete – Sprayed concrete test panel</td>
<td>Approval of sample panels</td>
<td>2 working days</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 LOADING

Loads on minor concrete structures
Prohibition: Avoid application of superimposed load on any part of what will become a load bearing structure within 21 days after placing concrete unless the structure is effectively and independently supported to the satisfaction of the Superintendent or until the Contractor can demonstrate that 95% of the design strength of the concrete has been achieved. This is a HOLD POINT.

2.2 PRODUCT CONFORMITY

Requirement
General: Submit current assessments of conformity, as follows:
- Certificate of conformity by a JAS-ANZ accredited third party.
- Declaration of conformity by an AS/NZS ISO 9001 quality management system certified supplier.
- Mark of conformity of a JAS-ANZ accredited third party applied to the product.
- Report by a NATA accredited laboratory describing tests and giving results which demonstrate that the product conforms.

Curing compounds: If it is proposed to use a liquid membrane-forming curing compound submit the following information:
- Certified test results for water retention to AS 3799 Appendix B.
- Evidence of compatibility with concrete, and with applied finishes including toppings and render, if any, including methods of obtaining the required adhesion.
- For visually important surfaces, evidence that an acceptable final surface colour will be obtained. This is a **WITNESS POINT**.

### 2.3 DESIGN DOCUMENTATION

**Requirement**
Formwork design: Conform to AS 3610.1.
Certification: For other than profiled steel sheeting composite formwork, submit certification by a professional structural engineer experienced in formwork design verifying conformance of the design.
This is a **HOLD POINT**.
- Loading: Submit details of proposed construction systems, loads and procedures, including propping and re-shoring. This is a **HOLD POINT**.

### 2.4 CERTIFICATES OF COMPLIANCE

**Requirement**
Verification: Provide certificates from a NATA registered laboratory. Perform all phases of any particular test at one laboratory. Accompany the certificate with all relevant test results carried out within twelve months of the submission date. This is a **WITNESS POINT**.
General: Use materials only after receipt of the Superintendent’s notification of acceptance of test reports and other submissions, and then only if they conform to this worksection.

### 2.5 SELECTIONS

**General**
All selection schedules are located in the Annexure A.

### 3 MATERIALS

#### 3.1 GENERAL

**Stockpile**
General: If uniform, consistent colour is required, stockpile sand, cement and aggregates for the project.

**Cement**
Standard: To AS 3972.
Age: Less than 6 months old.
Storage: Store cement bags under cover and above ground.

**Aggregates**
Standard: To AS 2758.1.
Coarse aggregate: Grading to AS 1141.11 and limits of deviation to AS 2758.1 Table 2.
Fine aggregate: Grading to AS 1141.11 and limits of deviation to AS 2758.1 Table 3.
Aggregate properties: Conform to the **Aggregate property schedule**.
Special aggregates: Stockpile special aggregates at the beginning of the project to minimise colour and other variations.

**Water**
Standard: To AS 1379.
Quality: Provide clean water, free from oil, acid, alkali, organic or vegetable matter and including not more than 500 mg/l of chloride ions.

**Polymeric film underlay**
Vapour barriers and damp-proofing membranes: To AS 2870 clause 5.3.3.

**Chemical admixtures**
Chemical admixtures: To AS 1478.1.
Chemical admixture content: Free of chlorides, fluorides and nitrates.

**Curing compounds**
Curing compounds: To AS 3799.

#### 3.2 CONCRETE

**Properties**
Concrete mix and supply: Conform to the following:
- Normal-class: To AS 1379 clause 1.5.3.
Properties: Conform to the Concrete properties schedule - performance.
- Special-class: To AS 1379 clause 1.5.4.
  Properties: Conform to the Concrete properties schedule - performance.

Cover
Concrete cover generally: To AS 3600.
Concrete cover for structures for retaining liquids: To AS 3735.
Concrete cover for residential ground slabs and footings: To AS 2870.

3.3 FORMWORK

General
Linnings, facings and release agents: Form for compatibility with applied finishes.
Lost formwork: Provide lost formwork which is without chlorides, and without impairment to the structural performance of the concrete members.
Void formers: Material capable of maintaining rigidity and shape until the concrete has set, withstanding construction loads and non-collapsible on absorption of moisture.

Steel decking
Profiled steel sheeting composite formwork: Minimum steel grade G550.
Corrosion protection: Zinc coating weight of [complete/delete]
Accessories: Adopt material and corrosion protection to match the profiled steel sheeting.

Plywood formwork
Material: Plywood sheeting to AS 6669.
Grade: To meet the design dimensions, loading and surface quality specified to AS 3610 and AS 3610.1.
Joints: Seal the joints consistent with the surface finish class.

3.4 REINFORCEMENT

Fibre reinforcement
Standard: To CIA CPN35.

Steel reinforcement
Standard: To AS/NZS 4671.
Type: [complete/delete]
Ductility grade: [complete/delete]
Surface condition: Free of loose mill scale, rust, oil, grease, mud or other material which would reduce the bond between the reinforcement and concrete.

Protective coating
Corrosion: Protect from corrosion in conformance with AS 3600.
Epoxy coating: High build, high solids chemically resistant coating.
- Thickness: 200 µm minimum.
Galvanizing: To AS/NZS 4680:
  - Sequence: If fabrication is to occur after galvanizing, submit proposals for galvanizing repair and coating of cut ends.
  - Zinc-coating (minimum): 600 g/m².

Tie wire
General: Annealed steel 1.25 mm diameter (minimum).
External and corrosive applications: Galvanized.

3.5 MISCELLANEOUS

Coloured concrete
Standard: To AS 3610.1.
Manufacture: Using the same mix and method used in the works, supply sample blocks of concrete before colouring with mineral oxides.
- Number: 4.
- Size (nominal): 300 x 300 x 50 mm.
Surface hardeners, sealants and protectors
Material supply: If required by the project documentation, provide proprietary products in conformance with the manufacturer’s written requirements.

3.6 MINOR PRECAST UNITS

Marking
Identification: Identify units by marks which are as follows:
- Remain legible until after the unit has been fixed in place.
- Are not visible in the completed structure.
- Show the date of casting.
- Show the correct orientation of the unit.
- On other than units manufactured as a standard product, indicate the locations within the structure in conformance with the marking plan.

Structural performance requirements
Comply with the following requirements: [complete/delete]

Tolerances
Fixings and embedded items in precast units: To AS 3610.1, as applicable.
Attachments
Sealing: Recess lifting attachments such as ferrules, or other types of cast-in fixings, and provide plugs for sealing.
Welding of connections
Standard: To AS/NZS 1554.3.

4 EXECUTION

4.1 GROUND PREPARATION

Base preparation
General: According to base type, as follows:
- Concrete working base: Remove projections above the plane surface, and loose material.
- Graded prepared subgrade: Blind with sufficient sand to create a smooth surface free from hard projections. Wet the sand just before laying the underlay. This is a HOLD POINT.

Polymeric film underlay installation
General: Lay over the base, lap joints at least 200 mm and seal the laps and penetrations with waterproof adhesive tape. Face the laps away from the direction of concrete pour. Take the underlay up vertical faces past the damp proof course where applicable, and tape fix at the top. Patch or seal punctures or tears before pouring concrete. Cut back as required after concrete has gained strength and forms have been removed. This is a HOLD POINT.

Rock foundations
Minimum depth: Extend the excavation for a minimum depth of 150 mm into the rock for retaining walls, headwalls and wingwalls
Cut-off walls: Provide a depth of cut-off in rock foundations less than that shown in the drawings, if approved by the Superintendent.

Mass concrete bedding on earth foundations (concrete blinding slab)
Concrete walls: Prior to the construction of footings for cast-in-situ concrete walls on earth foundations, cover the latter with a mass concrete blinding slab.
Precast concrete: Unless otherwise specified, place precast concrete wall sections on a fresh mass concrete bedding layer while it is still in a plastic state.
Earth foundation: Place concrete not less than 50 mm thick.
Rock foundation: Place the concrete at least 50 mm above the highest points of rock.
Restriction: Place neither forms nor other materials on the bedding layer within 48 hours of the concrete being placed. This is a WITNESS POINT.

4.2 CONCRETE QUALITY REQUIREMENTS

Formwork
Formed element: AS 3610.1 clause 5.2.2.
Position: Construct formwork so that finished concrete conforms to AS 3600 clause 17.5.
Erection tolerances: Check dimensions and position of forms, after the forms are erected. Align forms accurately and check the location of all fittings and void formers prior to placing concrete. This is a **WITNESS POINT**.

**Surface quality**

Formed surfaces: To AS 3610.1 for the surface class nominated in the **Formed surface finishes schedule**. This is a **WITNESS POINT**.

**Flatness**

Unformed surfaces: Conform with the **Flatness tolerance class table** for the class of finish nominated using a straight edge placed anywhere on the surface in any direction. This is a **WITNESS POINT**.

**Flatness tolerance class table**

<table>
<thead>
<tr>
<th>Class</th>
<th>Measurement</th>
<th>Maximum deviation (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>3 m straight edge</td>
<td>3</td>
</tr>
<tr>
<td>B</td>
<td>3 m straight edge</td>
<td>6</td>
</tr>
<tr>
<td>C</td>
<td>600 mm straight edge</td>
<td>6</td>
</tr>
</tbody>
</table>

**Type and frequency**

Sampling, identification and testing of specimens: Sample the concrete on site, at the point of discharge from the agitator to AS 1012 and AS 1379.

Frequency: To *0161 Quality (Construction)* Sub-annexure C14.

Records and reports: To AS 1012.

Test certificates and records: Submit test certificates, and also retain results on site.

Location: [complete/delete]

**Concrete testing methods**

Slump: Test at least one sample from each batch before placing concrete from that batch in the work.

Strength grade/Characteristic compressive strength: Spread the site sampling evenly throughout the concrete placement.

- Sampling frequency: To the **Project assessment strength grade sampling table**.
Project assessment strength grade sampling table

<table>
<thead>
<tr>
<th>Number of batches for each type and grade of concrete per day</th>
<th>Minimum number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2-5</td>
<td>2</td>
</tr>
<tr>
<td>6-10</td>
<td>3</td>
</tr>
<tr>
<td>11-20</td>
<td>4</td>
</tr>
<tr>
<td>each additional 10</td>
<td>1 additional</td>
</tr>
</tbody>
</table>

Cores and test acceptance
General: If the test specimens fail to achieve the specified strength, arrange for cores to be taken from the work. Submit locations of proposed cores for approval. This is a WITNESS POINT.
Acceptance: For acceptance, demonstrate compliance of the average strength of cores with the requirements of the Concrete age conversion factors table and the Concrete strength requirements table.
Strength age factor
Increase: If the testing is carried out at ages in excess of 28 days, validate against the 28 day strength increased by the factors given in the Concrete age conversion factors table.
Failure of cores
Deduction: If cores taken fail to satisfy the strength requirements, apply the deduction provisions in Measurement and payment.

Concrete age conversion factors table

<table>
<thead>
<tr>
<th>*Age of test specimen in days of date of testing</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 and greater</td>
<td>1.25</td>
</tr>
</tbody>
</table>

*For intermediate ages the factor shall be determined by proper interpolation.

Coarse aggregate
Wear: To AS 1141.23.
Loss of weight: < 30%.
Standard tests: When required, test coarse aggregate for conformance to the following properties:
- Aggregate crushing value: To AS 1141.21: < 25%.
- Soundness: To AS 1141.24.
- The loss of mass when tested with sodium sulphate: < 12%.
- Particle Shape: To AS 1141.14.
- The proportion of misshapen particles (2:1 ratio): < 35%.

Control tests
General: Determine strength using site cured specimens in conformance with the Control tests schedule.

Embedded pressure pipes
General: If leak tests have not been successfully completed, do not embed pipes.
Liquid retaining structures
Testing for liquid tightness: To AS 3735.

Test authority
General: Concrete supplier or NATA registered laboratory.

4.3 FORMWORK

General
Standard: To AS 3610.1.
Certification and inspection: Submit certification by a professional structural engineer experienced in formwork design and construction verifying conformance of the completed formwork, including the suitability of the formwork for the documented surface finish class. This is a HOLD POINT.

Requirements
Profile: Provide formwork to produce hardened concrete to the lines, levels and shapes documented.
Robustness: Provide formwork of adequate strength to carry all applied loads, including the pressure of fresh concrete, vibration loads, weight of workers and equipment, without loss of shape.
Stripping: Provide forms for removal without risk of damage to the completed structure.
Side forms: Where concrete is placed in earth excavations, provide side forms to prevent contact between concrete and the in situ earth.
Design for placement of concrete: Design formwork so that for high sections concrete cannot fall freely for a height greater than 1.2 m or so that concrete is not moved along the formwork after deposition.
Formwork fittings: Make provision for the accurate location and firm support of fittings, bolts, anchorages and formers of holes as documented.
Temporary fittings for the support of the formwork: Arrange to permit removal without damage to the concrete.
Projection: Do not use wires and or bolts extending to the surface of the concrete except where documented or approved by the Superintendent.

Finish
General: Conform to the Formed surfaces finishes schedule.

Material
Formwork material: Provide the type and quality of material for formwork and the workmanship in construction to obtain the surface finish documented. Construct to achieve the erection tolerances.

Preparation
Cleaning: Before placing concrete, remove free water, dust, debris and stains from the forms and the formed space.

Corners
All work above ground: Fillet at re-entrant angles, and chamfer at corners.
- Face of bevel 25 mm.

Embedments
General: Fix embedments through formwork to prevent movement, or loss of slurry or concrete, during concrete placement.

Openings
General: In vertical forms provide form openings or removable panels for inspection and cleaning, at the base of columns, walls and deep beams.
Access: For thin walls and columns, provide access hatches for placing concrete.

Release agents
Application: Before placing reinforcement, apply a release agent to form linings and facings.
Staining: If commercial quality form oil or grease are used, ensure that surfaces to be exposed will not become stained or discoloured.
Application: Spread the coating uniformly in a thin film and remove any surplus prior to placing concrete.
Unlined timber forms: Wet the timber thoroughly before oiling.

Steel decking
Fixing: If sheeting cannot be fixed to structural steel supports with puddle welds, or with welded shear studs in composite construction, provide details.
Steel linings
Rust: Clean off any rust and apply rust inhibiting agent prior to reuse.

Visually important surfaces
General: For concrete of surface finish classes 1, 2 or 3, set out the formwork to give a regular arrangement of panels, joints, bolt holes, and similar visible elements in the formed surface.
Formwork panels: Provide formwork for exposed surfaces from panels having uniform widths of not less than 1 m and uniform lengths of not less than 2 m, except where the dimensions of the member formed are less than the specified panel dimensions.
Pattern: Place all form panels in a neat, symmetrical pattern.
Plywood panels: Placed with the grain of the outer plies perpendicular to the studding or joists.
- Thickness: Not less than 15 mm thick, where attached directly to the studding or joists.
- Variations: If form panels are less than 15 mm thick, otherwise conforming to these requirements, provide a continuous backing of dressed material of 20 mm minimum thickness.

Side forms: Where concrete is placed in earth excavations, side forms shall be provided to prevent contact between concrete and the in situ earth.
Mild steel form surfaces: Customise all bolt and rivet heads counter-sunk and grind back all welds to even and smooth surfaces.
Joints: Provide joints in the formwork perpendicular to the main axis of the shape of the concrete.

Hidden surfaces
General: Construct forms for all surfaces which will be completely enclosed or permanently hidden below the ground from dressed or undressed timber, steel, plywood or particleboard.

Void formers
Use: Cast designated suspended ground floor slabs and beams on void formers.
Protection: Keep void formers dry until use, place them on a firm level surface and place reinforcement and concrete with minimum delay.
Void formers: Submit test certificates to confirm that the formers comply with the following requirements under laboratory conditions, when placed on damp sand and loaded with a mass of wet concrete equal to at least the mass of the beams or slabs they are required to support:
- Deflection during placing and compaction of the concrete is less than the span of the beam or slab divided by 1000.
- Additional deflection between initial set and 7 days does not exceed span/400.
- Collapse and loss of load carrying capacity will occur not more than 48 hours after flooding with water, creating a void at least 60% of the original depth of the void former. This is a WITNESS POINT.

4.4 CONCRETE SUPPLY

General
General: Provide concrete in conformance with the Concrete properties schedule - performance.

Strength requirement
Variation: For departure from the minimum requirements cited in the Concrete strength requirements table reference a specific minimum cement content on the drawings, or submit for approval.

Concrete strength requirements table

<table>
<thead>
<tr>
<th>Use</th>
<th>MPa</th>
<th>Minimum Portland cement GP (GB)</th>
<th>Coarse aggregate nominal size</th>
<th>Cylinder strength required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Kg/m³</td>
<td>mm</td>
<td>7 days</td>
</tr>
<tr>
<td>Foundations, mass retaining walls</td>
<td>20</td>
<td>270 (330)</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>Mass concrete footings, pitching, linings etc.</td>
<td>20</td>
<td>270 (330)</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Drainage structures, driveways, footpaths, miscellaneous minor concrete work</td>
<td>20</td>
<td>270 (330)</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>
Use | MPa | Minimum Portland cement GP (GB) | Coarse aggregate nominal size | Cylinder strength required |
--- | --- | --- | --- | --- |
--- | --- | Kg/m³ | mm | MPa | MPa |
Reinforced concrete culverts, headwalls, base slabs, sign structure large footings, retaining walls | 32 | 320 (380) | 20 | 24 | 32 |
Safety barriers | 40 | 330 (380) | 20 | 24 | 40 |
Extruded concrete | 20 | 270 (330) | 14 | 15 | 20 |

**Elapsed delivery time**

General: Ensure that the elapsed time between the wetting of the mix and the discharge of the mix at the site is in conformance with the **Elapsed delivery time table**. Do not discharge at ambient temperature below 10°C or above 30°C unless approved measures are taken by heating or cooling so that the delivered concrete is within the range 5°C - 35°C.

**Elapsed delivery time table**

<table>
<thead>
<tr>
<th>Concrete temperature at time of discharge (°C)</th>
<th>Maximum elapsed time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 – 24</td>
<td>120</td>
</tr>
<tr>
<td>24 – 27</td>
<td>90</td>
</tr>
<tr>
<td>27 – 30</td>
<td>60</td>
</tr>
<tr>
<td>30 – 32</td>
<td>45</td>
</tr>
</tbody>
</table>

**Pre- mixed supply**

Addition of water: To AS 1379 clause 4.2.3 if water is approved for addition.

Transport: Mode must prevent segregation, loss of material and contamination of the environment, and must not adversely affect placing or compaction.

**4.5 STEEL REINFORCEMENT PLACEMENT**

**Tolerances**

Fabrication and fixing: To AS 3600 clause 17.2.

**Dowels**

Fixing: If a dowel has an unpainted half, embed this in the concrete placed first.

Tolerances:
- Alignment: 2 mm in 300 mm.
- Location tolerance: ± half the diameter of the dowel.

Grade: 250 N.

**Supports**

General: Provide proprietary concrete, metal or plastic supports to reinforcement in the form of chairs, spacers, stools, hangers and ties, as follows:
- With a protective coating if they are ferrous metal extending to the surface of the concrete, or are used with galvanized or zinc-coated reinforcement.

Minimum spacing:
- Bars: ≤ 60 diameters.
- Fabric: ≤ 800 mm.

Supports over membranes: Prevent damage to waterproofing membranes or vapour barriers. If appropriate, place a metal or plastic plate under each support.

**Projecting reinforcement**

General: If ‘starter’ or other bars project beyond reinforcement mats or cages, through formwork or from cast concrete, provide a plastic protective cap to each bar until it is incorporated into subsequent work.
Tying
General: Secure the reinforcement against displacement by tying at intersections with either wire ties, or clips. Bend the ends of wire ties away from nearby faces of forms so that the ties do not project into the concrete cover.
Beams: Tie stirrups to bars in each corner of each stirrup. Fix other longitudinal bars to stirrups at 1 m maximum intervals.
Columns: Secure longitudinal column reinforcement to all ties at every intersection.
Mats: For bar reinforcement in the form of a mat, secure each bar at alternate intersections

Welding
General: If welding of reinforcement is proposed, provide details.

Bending
General: Do not be bend or straighten in a manner that will injure the material. Do not provide bars with kinks or bends not documented.
- Heating: Do not use heat to bend or straighten reinforcement.

Splicing
Plan lengths: Provide all reinforcement in the lengths documented. If splicing is required conform to AS/NZS 4671.
Testing of splices not as shown on the drawings: Costs to the Contractor.
Lapped splices: Provide laps in reinforcing bars, wire or fabric as shown on the drawing or as follows:
- Plain bars, Grade 250: Minimum 40 bar diameters.
- Deformed bars, Grade 400: Minimum 35 bar diameters.
- Hard-drawn wire: Minimum 50 bar diameters.
- Securely wired together in at least two places, unless welded.
Splicing in reinforcing fabric: Provide an overlap, measured between outermost transverse wires of each sheet of fabric of not less than the spacing of those wires plus 25 mm.
Staggering: Stagger splices as shown on the drawings or submit proposal for approval.

Marking
Bundles: Bundle bars of identical shape in bundles of three and securely tie together by soft iron wire.
Label: Provide each bundle with a stout metal label of not less than 40 mm diameter.
Marking: Ensure that each metal label has been punched with the appropriate marking in conformance with the documented steel list.
Prefix: If documented, ensure that the marking incorporates a prefix. Store bars with different prefixes separately.

Storage
General: Store reinforcement above the surface of the ground and protect from damage and from deterioration by exposure.

Delivery and receipt of reinforcement
Test before delivery: If it is proposed to have the reinforcement tested off-site, obtain the approval before reinforcement is delivered to site. This is a WITNESS POINT.
Payment: No extra payment will be made as a result of any delays incurred by the Superintendent carrying out, or waiving, the inspection with reasonable expediency.

Placing
Reinforcement position: Place reinforcement as documented and hold securely by blocking from the forms, by supporting on concrete or plastic chairs, or metal hangers, and by wiring together at all intersections or at 0.5 m centres, whichever is the greater distance, using annealed iron wire of diameter not less than 1.25 mm.
Prohibition: Do not support steel on metal supports which extend to the surface of concrete, on wooden supports, or on pieces of coarse aggregate.
Cover: Provide reinforcement with the minimum cover documented, or as follows, but in no case less than 1.5 times the diameter of the bar:
- Concrete normally in contact only with air:
  - Slabs: 40 mm.
  - Other than slabs: 45 mm.
- Concrete in contact with earth or fresh water:
  - Slabs of box culverts: 50 mm.
. Other than culverts: 50 mm.

Reinforcement: If changes are proposed to reinforcement shown on the drawings, submit details. This is a WITNESS POINT.

Damaged galvanizing: If repair is required, submit proposals to AS/NZS 4680 Section 8. This is a WITNESS POINT.

Provision for concrete placement: If spacing, splicing, welding or cover of reinforcement does not comply give notice. This is a WITNESS POINT.

Tack welding

Approval: If the use of tack welding instead of wire ties on reinforcing wire is proposed, submit for approval.

Standard: All welding of reinforcing steel to AS 1554.3.

Prohibition: Do not tack weld cold-worked and hard grade bars.

Approval of reinforcement before concrete placement

General: Submit the approval for the reinforcement in each section of the work before any concrete is deposited in that section. Allow adequate time for inspections and any corrective work. This is a HOLD POINT.

4.6 CORES, FIXINGS AND EMBEDDED ITEMS

General

Cores, fixings and embedded items: Submit shop drawings showing the proposed locations, clearances and cover, and indicating proposed repositioning of reinforcement. This is a HOLD POINT.

Cutting or coring: If cutting or coring of hardened concrete is proposed, provide details. This is a WITNESS POINT.

Adjoining elements

General: For adjoining elements to be fixed to or supported on the concrete, provide for the required fixings. If required, provide for temporary support of adjoining elements during construction of the concrete.

Corrosion: If in external or exposed locations, galvanize anchor bolts and embedded fixings, or propose alternative materials such as stainless steel.

Position: Fix cores and embedded items to prevent movement during concrete placing. In locating cores, fixings and embedded items, reposition but do not cut reinforcement, and maintain cover to reinforcement.

Isolation: Isolate embedded items so that water cannot track to concrete providing minimum cover to reinforcement.

4.7 MIXING OF CONCRETE

Measurement of materials

General: Measure all materials by weight, except if required:

- Water: Measure by volume with an approved adjustable water-measuring and discharging device.
- Cement: Measure by bags as packed by the manufacturer. Proportion batches on the basis of one or more unbroken bags of cement, assumed to weigh 40 kg per bag.

Bulk cement: Weigh in an individual hopper and keep separate from the aggregates until the components of the batch are discharged from the batching hopper.

Measurement by volume: Submit for approval.

Mixing by weight: On-site mixing

Mixing by weight on site: If mixing concrete on site, and if mix control is likely to be less efficient than at a central batching plant, conform to the Materials in batch containing 1 bag (40 kg) cement table as a guide to produce the classes of concrete specified.

Small changes: Adopt small changes in the proportions of fine and coarse aggregate to improve density or workability of the concrete if required.

Materials in batch containing 1 bag (40 kg) cement table

<table>
<thead>
<tr>
<th>MPa</th>
<th>Cement (kg)</th>
<th>Fine aggregates (kg)</th>
<th>Coarse aggregates (kg)</th>
<th>Total aggregates (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>40</td>
<td>130</td>
<td>250</td>
<td>380</td>
</tr>
<tr>
<td>15</td>
<td>40</td>
<td>100</td>
<td>190</td>
<td>290</td>
</tr>
<tr>
<td>20</td>
<td>40</td>
<td>88</td>
<td>126</td>
<td>214</td>
</tr>
</tbody>
</table>
Variation in aggregate moisture content: If the moisture content of fine and coarse aggregates exceeds 8% or 3% respectively, adjust the proportions of the mix to compensate for the excess water in the aggregate.

**Measuring by volume: On-site mixing**

Mixing by volume on site: If measurement by volume is approved, proportion the materials to produce a mix free of voids and having the specified strength at 28 days.

Volume batching: Adopt the nominal proportions given in **Volume batching table** may be used as a guide for volume batching.

**Volume batching table**

<table>
<thead>
<tr>
<th>MPa</th>
<th>Parts by volume</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cement</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td>1</td>
</tr>
</tbody>
</table>

Fine aggregate bulking: If the fine aggregate contains sufficient moisture to produce ‘bulking’ in excess of 10%, increase the volume of fine aggregate a corresponding amount.

Batch measurement: Measure the volumes of fine and coarse aggregates for each batch in boxes or bins, to details approved by the Superintendent including:

- Measure the aggregates loose (i.e. without compaction) in the boxes and strike off level.
- Do not undertake measurements by shovels or like methods.
- Arrange batch proportions for each batch to contain 1 bag of cement. Assume one 40 kg bag of cement to have a volume of 27.5 litres.

**Consistency**

General: If approved add sufficient quantity of water to the mix so that the consistency of the concrete enables it to be placed in the forms, compacted and worked into all corners without permitting the ingredients to segregate, or excess free water to collect on the surface.

Standard: Determine the consistency of the concrete to AS 1012.3.1.

Slump: Except for extruded concrete, concrete slump \(\leq 75\) mm for concrete compacted by vibrators.

Extrusion machine: If concrete is placed by an extrusion machine, provide only sufficient water in the mix to produce a slump of 10 mm to 15 mm.

Mechanical mixing: Mix all concrete with mechanically operated mixers. If there is an emergency, provide proposals for hand mixing.

Mixing location: Submit proposal for concrete mixing location. This is a **WITNESS POINT**

Segregation of concrete: Reject any concrete which exhibits signs of segregation as directed by the Superintendent.

**Mixing at site**

Machine mixing at site: Conform to the following:

- Mixer requirements: Adopt a batch mixer which will ensure a uniform distribution of the materials throughout the batch.
- Mixer capacity: Provide a mixer with capacity for one or more whole bags of cement to be used per batch of concrete. Do not exceed the manufacturer’s rated capacity of the mixer with the volume of the mixed material.
- Mixing time: Allow a mixing time for each batch of not less than 1.5 minutes after all ingredients are assembled in the mixer, and prior to any portion of the batch being removed.
- Total mix discharge: Discharge the entire contents of a batch from the mixer before any materials are placed therein for the succeeding batch.

**Mixing in an emergency**

Mixing in an emergency: Conform to the following:

- Hand mixing: If there is a breakdown of the mechanical mixing equipment, seek approval of the Superintendent to hand mix in small quantities so as to complete a section of the work or reach a suitable construction joint.
- Hand mixing conditions: Hand mix on an approved water-tight platform of sufficient size to allow the mixing of at least two batches simultaneously. Use an amount of cement 10% more than the amount specified for machine mixed concrete.
- Hand mixing procedure:
  . First mix the fine aggregate and cement until a uniform colour is obtained, and then spread on the mixing platform in a thin layer.
  . Spread the coarse aggregate, previously drenched with water, over the fine aggregate and cement in a uniform layer, and turn the whole mass over as further water is added with a rose sprinkler.
  . After the water is added, turn the mass at least three times, not including shovelling into barrows or forms, until the mixture is uniform in colour and appearance.
- Hand-mixed batches: Do not exceed 0.25 cubic metres each.

Pre-mixed supply
Delivery docket: For each batch, submit a docket listing the information required by AS 1379, and the following information:
- For special class performance concrete, specified performance and type of cement binder.
- For special class prescription concrete, details of mix, additives, and type of cement binder.
- Method of placement and climate conditions during pour.
- Name of concrete delivery supervisor.
- Project assessment carried out each day.
- The amount of water, if any, added at the site.
- The concrete element or part of the works for which the concrete was ordered, and where it was placed.
- The total amount of water added at the plant and the maximum amount permitted to be added at the site.

Subcontractors: Submit names and contact details of proposed pre-mixed concrete suppliers, and alternative source of supply in the event of breakdown of pre-mixed or site mixed supply. This is a WITNESS POINT.

4.8 CONCRETE PLACING AND COMPACTION

Placing
Activities include: Taking delivery of fresh concrete, placing, transfer and/or finishing the concrete into its final position.
Sequence of placement: If sequential placement of slab segments is proposed, provide details. This is a WITNESS POINT.
Preparation: Clean and moisten the area prior to placing concrete: Remove any ponding water.
Method: Use placing methods which avoid segregation and loss of concrete, and which minimise plastic settlement. Maintain a generally vertical and plastic concrete edge during placement.
Layers: Place concrete in layers \( \leq 300 \) mm thick, such that each succeeding layer is compacted before previous layer has taken initial set. Compact into previous layer.
Conveying equipment: Provide conveying equipment including open troughs and chutes, where required, of metal, or with metal linings.
Steep slopes: Provide troughs and chutes with baffles, or place in short lengths in such a way that the direction of flow of the concrete is changed.
Positioning of chutes: Provide chutes long enough to permit delivery to the whole of the area enclosed by the forms.
Discharge of cleaning water: Discharge the water used for flushing the chutes and for cleaning in an area acceptable to the Superintendent.

Compaction
Methods: Use immersion and screed vibrators accompanied by hand methods as appropriate to remove entrapped air and to fully compact the mix.
Vibrators: Do not allow vibrators to come into contact with set concrete, reinforcement or items including pipes and conduits embedded in concrete. Do not use vibrators to move concrete along the forms. Avoid over-vibration that may cause segregation.

Placing records
General: Keep on site and make available for inspection a log book recording each placement of concrete, including the following:
- Date.
- Specified grade and source of concrete.
- Slump measurements.
- The portion of work.
- Volume placed.

**Rain**

General: During placement and prior to setting, do not expose concrete to rain.

Protection: Protect surface from damage by covering until hardened.

**Time between adjacent placements**

General: Conform to the Minimum time delay schedule.

**Slurry for extruded concrete**

General: If concrete is placed by an extrusion machine place in the special receptacle in the machine, if the machine is so equipped, mix small quantities of cement-sand slurry, comprised of two parts of plasterer’s sand and one part of cement (by volume), together with sufficient water to bring it to a semi-fluid condition, and feed onto the surface of the concrete at a rate sufficient to produce a smooth and uniform finish.

**Concrete placing in cold weather**

**Cold-Weather Concreting**

Cement: Do not use high alumina cement.

Placing concrete: Maintain the temperature of the freshly mixed concrete at \( \geq 5 \)°C.

Formwork and reinforcement: Before and during placing maintain temperature at \( \geq 5 \)°C.

Severe weather: If severe weather conditions are predicted, use high early strength cement.

Temperature control: Heat the concrete materials, other than cement, to the minimum temperature necessary to ensure that the temperature of the placed concrete is within the limits specified.

Admixtures: Do not use calcium chloride, salts, chemicals or other material in the mix to lower the freezing point of the concrete.

Frozen materials: Do not allow frozen materials or materials containing ice to enter the mixer, and keep free of frost and ice any forms, materials, and equipment coming in contact with the concrete.

Maximum temperature of water: 60°C when it is placed in the mixer.

**Concrete placing in hot weather**

**Hot-Weather Concreting**

Handling: Prevent premature stiffening of the fresh mix and reduce water absorption and evaporation losses. Mix, transport, place and compact the concrete in conformance with the Elapsed delivery time table.

Placing concrete: Maintain the temperature of the freshly mixed concrete in conformance with the Hot weather placing table.

Formwork and reinforcement: Before and during placing maintain temperature at \( \leq 35 \)°C.

Temperature control: Select one or more of the following methods of maintaining the specified temperature of the placed concrete at 35°C:

- Cool the concrete using liquid nitrogen injection before placing.
- Cover the container in which the concrete is transported to the forms.
- Spray the coarse aggregate using cold water prior to mixing.
- Use chilled mixing water.

**Hot weather placing table**

<table>
<thead>
<tr>
<th>Concrete element</th>
<th>Temperature limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal concrete in footings, beams, columns, walls and slabs</td>
<td>35°C</td>
</tr>
<tr>
<td>Concrete in sections ( \geq 1 ) m in all dimensions except for concrete of strength 40 MPa or greater, in sections exceeding 600 mm in thickness</td>
<td>27°C</td>
</tr>
</tbody>
</table>

Evaporation control barriers: Erect barriers to protect freshly placed concrete from drying winds.

**Concrete placing under water**

Condition: If placing in the dry is practicable by pumping or other means of dewatering, do not place under water.

Minimum cement content for the mix: Increase by 25%.

Method: If required, submit proposals. This is a Witness Point.
4.9 CONCRETE CURING

General
Requirements: Taking into account the average ambient temperature at site over the relevant period affecting the curing, adopt procedures to ensure the following:
- Curing: Cure continuously from completion of finishing until the total cumulative number of days or fractions of days, during which the air temperature in contact with the concrete is above 10°C, is at least the following, unless accelerated curing is adopted:
  . Fully enclosed internal surfaces/Early age concrete: 3 days.
  . Other concrete surfaces: 7 days.
- End of curing period: Prevent rapid drying out at the end of the curing period.
- Protection: Maintain at a reasonably constant temperature with minimum moisture loss, during the curing period.

Curing method: [complete/delete]

Cold weather curing
General: Maintain concrete temperature between 10 – 20°C for curing period.

Curing compounds
Standard: To AS 3799.
Application: Provide a uniform continuous flexible coating without visible breaks or pinholes, which remains unbroken at least for the required curing period after application.
Substrates: Do not use wax-based or chlorinated rubber-based curing compounds on surfaces forming substrates to applied finishes, concrete toppings and cement-based render.
Self levelling toppings: If used also as curing compounds, confirm compliance with AS 3799.
Visually important surfaces: Apply curing compounds to produce uniform colour on adjacent surfaces.

Hot weather curing
Curing compounds: If it is proposed to use curing compounds, provide details.
Protection: Select a protection method as applicable.
- If the concrete temperature exceeds 25°C or if not protected against drying winds, protect the concrete using a fog spray application of aliphatic alcohol evaporation retardant.
- If ambient shade temperature exceeds 35°C, protect from wind and sun using an evaporative retarder until curing is commenced.
- Immediately after finishing, either cover exposed surfaces using an impervious membrane or hessian kept wet until curing begins, or apply a curing compound.

Water curing
General: If water is used, pond or continuously sprinkle in such a way as to not cause damage to the concrete surface, for the required curing period.

4.10 JOINTS

General
Sawn joints: Submit proposed methods, timing and sequence of sawing joints. This is a WITNESS POINT.

Horizontal construction joint
Location: If horizontal construction joints are found to be necessary in walls, or cast-in-situ drainage structures, make the joints at the base of walls and at other locations in the walls where approved by the Superintendent.
Preparation: In order to provide for bond between the new concrete and the concrete which has already set, clean the surface on which the new concrete is to be placed of loose material, foreign matter and laitance prior to:
- Roughening or keying and saturating with water.
- Removing any excess water, and thinly coating the surface with a neat cement grout.

Retaining wall vertical expansion joints
Location: Provide vertical expansion joints as documented.
Material: Provide jointing material of approved quality, and of thickness as documented, for the full depth of the joint.
Trim: Trim to match the surface of the concrete.
Footpaths, medians, driveways
Location: In footpaths, median toppings and driveways, unless otherwise documented, provide expansion joints 15 mm in width for the full depth of paving, constructed at intervals not exceeding 15 m and where the pavement abuts against gutters, pits and structures.
Material: Preformed jointing material of bituminous fibreboard or approved equivalent.

Unreinforced paving
Location: Provide all unreinforced paving with narrow vertical grooves, 20 mm deep to induce contraction joints for the control of cracking.
Timing and set out: Form joints in the freshly placed concrete in a neat regular pattern to form ‘slabs’ no bigger than 2 m square.
Proportion: The ratio of the longest side to the shortest side ≤ 1.6.

Expansion joints
Joint filling: Fill with jointing materials as documented. Finish visible jointing material neatly flush with adjoining surfaces.
Preparation: Before filling, dry and clean the joint surfaces, and prime.
Watertightness: Apply the jointing material so that joints subject to ingress of water are made watertight.
Jointing materials: Provide jointing materials compatible when used together, and non-staining to concrete in visible locations.
Bond breaking: Provide back-up materials for sealants, including backing rods, which do not adhere to the sealant. They may be faced with a non-adhering material.
Foamed materials (in compressible fillers): Closed-cell or impregnated types which do not absorb water.

Slip joints
Requirement: If concrete slabs are supported on masonry, provide proprietary slip joints.

4.11 FORMED SURFACES

General
General: Provide formed concrete finishes in conformance with the Formed surface finishes schedule.
Damage: Do not damage concrete works through premature removal of formwork.
Surface repair method: If required, submit details of the proposed method before commencing repairs. This is a WITNESS POINT.

Curing
General: If forms are stripped when concrete is at an age less than the minimum curing period, commence curing exposed faces as soon as the stripping is completed.

Quality of surfaces
General: Provide concrete surfaces which are true and even, free from stone pockets, depressions or projections beyond the surface. Ensure all arrises are sharp and true, and mouldings evenly mitred or rounded.
Repair of defects
General: As soon as the forms are removed from mass or reinforced concrete work, repair all rough places, holes and porous spots by removing defective work and after wetting, filling with stiff cement mortar having the same proportions of cement and fine aggregate as used in the concrete, and bring to an even surface with a wooden float. Similarly repair all cavities caused by removal of fitments or tie wires and pack with cement mortar.
Removal of the wires: Cut back any tie wires or other fitments extending to outside surfaces after removal of forms, to a depth of at least 40 mm with sharp chisels or cutters.
Coating with bonding agent: If required, coat the surfaces of bolt cavities, tie wire holes, and all defects prior to the placing of mortar, grout, or fresh concrete, with an approved bonding agent, in lieu of wetting with water, generally as required by the manufacturer.

4.12 REMOVAL OF FORMS

Formwork removal
Extent: Remove formwork, other than profiled steel reinforcement decking, including formwork in concealed locations, but excepting lost formwork.
Timing: Do not disturb forms until concrete is hardened enough to withstand formwork movements and removal without damage.
Stripping:
- General: To AS 3600 where it is more stringent than AS 3610.1.

**Walls, sumps and other structures**

General: Maintain all forms in place, after placement of concrete, for following minimum periods, or as extended by the Superintendent if the air shade temperature falls below 10°C:
- Mass retaining walls, headwalls, wingwalls, gully pits, sumps and similar drainage structures: 2 days.
- Footpaths, driveways and similar: 2 days.
- Sides of reinforced concrete walls when height of each day pour is:
  - Under 0.6 metres: 1 day.
  - 0.6 m to 3 m: 2 days.
  - 3 m to 6 m: 3 days.
  - 6 m to 9 m: 5 days.
- Supporting forms under deck slabs of culverts: 10 days.

Concrete containing special additives: In case of concrete containing special additives, conform to stripping times as determined by the Superintendent.

Protection of concrete during form removal: Remove forms so that the concrete will not be cracked, chipped or otherwise damaged. Do not use of crowbars or other levering devices exerting pressure on the fresh concrete to loosen the forms.

Removal of hole formers: Remove hole formers such as pipes and bars as soon as the concrete has hardened sufficiently for this to be done without damage to the concrete.

**Superimposed load**

Prohibition: Do not apply superimposed load to any part of a structure until the concrete has reached at least 70% of the design strength.

### 4.13 UNFORMED SURFACES

**General**

General: Strike off, screed and level slab surfaces to finished levels, to the tolerance class noted in the *Unformed surface finishes schedule*.

**Surface finishes**

General: Provide surface finishes in conformance with the *Unformed surface finishes schedule*.

**Surface repairs**

Surface repair method: If surface repairs are required, submit proposals.

Mortar capping: Not permitted.

**Finishing methods – surfaces other than wearing surfaces**

General: Compact and tamp so as to flush mortar to the surface, screed off and finally dress with a wooden float to an even surface, including to:
- Drain or otherwise remove promptly any water which comes to the surface.
- Roughen all future contact surfaces, with the coarse aggregate at the surface firmly embedded but not forced below the surface.

**Finishing methods – wearing surfaces**

General: Compact then screed off the surface with a vibrating screed, or hand screed if the distance between forms perpendicular to the direction of screed is no greater than 2 metres.

Correction: Immediately following compaction and screeding test and correct for high or low spots.

Tolerance: Conform to the following
- The finished surfaces of concrete structures not adjacent to road pavements – Deviation is ≤ 25 mm in plan position and ≤ 25 mm from the specified levels.
- In the case of drainage pits and other structures adjacent to road pavements, the finished concrete ≤ 10 mm from the specified levels and alignment.
- Longitudinal surfaces greater than 10 metres in length: Deviation from level or alignment < 5 mm from a straight-edge 3 metres long, subject to any necessary allowances on vertical and horizontal curves.

Final finish: Finish the surface true and uniform and free of any glazed or trowelling finish and finally dress with a wooden template or float, or by the use of belting in an approved manner.
Surface to receive asphalt: After compacting, screeding and correcting, dress with a wooden float and finally broom to produce a rough surface.
Textured patterned surface: Finish coloured, textured or patterned surfaces as directed by the Superintendent.

4.14 PRECAST UNITS

Handling
Lifting: Lift or support units only at designated or other approved points. Use handling methods which do not overstress, warp or damage the units.
Attachments
Remove temporary attachments after erection. Seal and make good residual recesses.
Installation
Fixing: Fix the units securely and accurately in their final positions.
Ancillaries: Provide components and materials, including fasteners, braces, shims, jointing strips, sealant, flashings, grout and mortar, necessary for the installation of the units.
Protection
General: Protect the units against staining, discolouration and other damage until they are installed in their final location.

Storage
Support points: Store elements at designated storage points.
Prevent damage: Adequately store units to prevent warping, twisting, crushing, cracking and staining.
Protection: Protect the units against staining, discolouration and other damage until they are installed in their final location.

Lifting and handling
Lifting and handling: Conform to the ASCC National code and AS 3850.
Site conditions: Ensure the wind and temperature conditions allow handling and fixing consistent with structural capability and geometry of the element.
Crane: To AS 2550.
Temporary bracing and propping: To AS 3850 and AS/NZS 1170.2.

4.15 SPRAYED CONCRETE

Materials
Standard to AS 3600.
Detail
Minimum depth: 75 mm.
Colour: Spray coloured concrete lining in open drains to match the adjoining rock colour.
Strength
Minimum cement content: 380 kg/m$^3$ as discharged from the nozzle.
Minimum compressive strength: 25 MPa at 28 days when tested by means of 75 mm diameter cores taken from in-place sprayed concrete.

Test cores
Securing, accepting, curing, capping and testing: To AS 1012.14.
Equipment and facilities: Provide for taking of the cores from the work.
Curing and testing: NATA registered laboratory.
Results: Submit copies of test results.

Method statement
General: Submit at least 14 days prior to applying any sprayed concrete including details of the proposed procedure, plant, materials and mix proportions. This is a WITNESS POINT.

Sprayed concrete Test panels
General: Conform to the following:
- Number and dimensions of panels: Not less than 10 days before applying concrete, prepare at least 3 test panels for each mix proposed, in conditions similar to those in the works and in the presence of the Superintendent.
- Make the test panels by applying a 75 mm thickness of sprayed concrete to a hardboard panel approximately 750 mm square.
- Apply the sprayed concrete to the panels in the same manner, using materials including steel reinforcing fabric, equipment, pressures and curing that will be used in the Works.
- Submit the panels for examination and approval.

Cores: Cut four 75 mm diameter cores from one test panel for each proposed mix approximately 48 hours after the panel has been sprayed and tests as follows:
- For cores from in-situ sprayed concrete. One core compression test at 3 days, one core at 7 days and the remaining two cores at 28 days.

Defective core: If any of the cores reveals defects such as lack of compaction, dry patches, voids or sand pockets or exhibits an unacceptable surface finish, modify the mix design and/or method of placement and prepare fresh test panels for testing and inspection.

Approval of panels: Apply sprayed concrete to the works only after test panels have been approved. This is a **WITNESS POINT**.

**Surface preparation**
Earth: Grade, trim, compact and dampen earth surfaces prior to applying the sprayed concrete. Take any necessary precautions to prevent erosion when the sprayed concrete is applied.
Rock: Clean off loose material, mud and other foreign matter that might prevent bonding of the sprayed concrete onto the rock surface. Dampen the rock surfaces prior to applying the sprayed concrete.
Steel pipes: Corrugated steel pipes are cleaned of loose material, mud and any other foreign matter.
Water flow: Remove free water and prevent the flow of water which could adversely affect the quality of the sprayed concrete.

**Application of sprayed concrete**
Procedure: Begin application at the bottom of the area being sprayed and build up making several passes of the nozzle over the working area.
Technique: Hold the nozzle so that the stream of material impinges as nearly as possible perpendicularly to the surface being coated.
Spraying around reinforcement: If spraying around reinforcement, spray concrete behind the reinforcement before concrete can accumulate on the face of the reinforcement.
Protection of adjoining surfaces: Protect adjoining surfaces not requiring sprayed concrete from splash and spray rebound.
Regulation: Regulate the velocity of discharge from the nozzle, the distance of the nozzle from the surface and the amount of water in the mix so as to produce a dense coating with minimum rebound of the material and no sagging.
Rebound: Remove and dispose of splash and rebound material from the surface after the initial set as work proceeds by air-water jet or other suitable means.
Wind problems: If wind causes separation of the nozzle stream, discontinue spraying.
Air temperature: If air temperature is less than 5°C, do not spray.

**Construction joints**
General: Keep construction joints to a minimum.
Forming: Form joint by placing or trimming the sprayed concrete to an angle between 30° and 45° to the sprayed concrete surface.
Preparation: Clean and wet by air-water jet the joint edge before recommencing concrete spraying.

**Curing**
Commencement: Commence curing within one hour of the application of sprayed concrete with water or colourless wax emulsion curing compound complying with AS 3799 and applied in conformance with manufacturer’s specifications.
Water curing: If water curing, keep the surface of the sprayed concrete continuously wet for at least seven days.

**4.16 COMPLETION**

**Loading**
General: Do not erect masonry walls or other brittle elements on beams and slabs while they are still supported by formwork.

**Unencased reinforcement**
General: If 'starter bars' and other items project from cast concrete for future additions and are exposed to the weather, provide details of protection.

**Protection**
Protection: Protect the concrete from damage due to construction load overstresses, physical and thermal shocks, and excessive vibrations, particularly during the curing period.
Surface protection: Protect finished concrete surfaces and applied finishes from damage.

## 5 LIMITS AND TOLERANCES

### 5.1 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><strong>Subgrade</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relative compaction</td>
<td>( \geq 95% ) (standard compactive effort).</td>
<td>Foundations</td>
</tr>
<tr>
<td><strong>Formwork</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position of forms</td>
<td>Align forms accurately so that departure of the forms from the surfaces specified on the drawings do not exceed 1/300 of the space between supports for any surface visible in the completed work and 1/150 for hidden work.</td>
<td>Erection</td>
</tr>
<tr>
<td><strong>Fine aggregate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grading</td>
<td>To be evenly graded within the absolute limits and not deviate from the grading of sample aggregate as per the Fine aggregate grading table to AS 2758.1 Table 3.</td>
<td>Fine aggregate</td>
</tr>
<tr>
<td>Coarse aggregate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of wear</td>
<td>Loss of weight (&lt; 30%).</td>
<td>Coarse aggregate</td>
</tr>
<tr>
<td>Crushing value</td>
<td>Crushing value (&lt; 25%).</td>
<td>Coarse aggregate</td>
</tr>
<tr>
<td>Soundness</td>
<td>The loss of mass when tested with sodium sulphate (&lt; 12%).</td>
<td>Coarse aggregate</td>
</tr>
<tr>
<td>Particle shape</td>
<td>The proportion of mis-shapen particles (2:1 ratio) (&lt; 35%).</td>
<td>Coarse aggregate</td>
</tr>
<tr>
<td>Grading</td>
<td>To be evenly graded within the absolute limits and not deviate from the grading of sample aggregate as per the Coarse aggregate grading table.</td>
<td>Coarse aggregate</td>
</tr>
<tr>
<td>Aggregate moisture content</td>
<td>Where moisture content of fine aggregate exceeds 8%, or moisture content of coarse aggregate exceeds 3%, change the proportion of mix.</td>
<td>Measuring by weight, on-site mixing</td>
</tr>
<tr>
<td>Bulking of fine aggregate</td>
<td>Where bulking of the fine aggregate exceeds 10%, make a corresponding increase in volume of fine aggregate.</td>
<td>Measuring by volume, on-site mixing</td>
</tr>
<tr>
<td>Consistency</td>
<td>In conformance with AS 1012.3.1, the slump (&lt; 75\text{ mm} ) for concrete compacted by vibrators.</td>
<td>Consistency</td>
</tr>
<tr>
<td></td>
<td>In the case of concrete placed by extrusion machine, the slump will be between 10 mm and 15 mm.</td>
<td>Consistency</td>
</tr>
<tr>
<td><strong>Finishing of unformed/ formed concrete surfaces</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wearing surface</td>
<td>To be finished true and uniform so that departure from designed grade (&lt; 5\text{ mm} ) in any 3 metre length.</td>
<td>Finishing of unformed surfaces</td>
</tr>
<tr>
<td><strong>Finished surfaces</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Not adjacent to roads | \( \leq 25\text{ mm plan position.} \)  
\( \leq 25\text{ mm level.} \) | Finishing of unformed surfaces |
| Adjacent to roads | \( \leq 10\text{ mm alignment.} \) | Finishing of unformed surfaces |
6 MEASUREMENT AND PAYMENT

6.1 MEASUREMENT

General
Payment to the schedule of rates: To 0152 Schedule of rates – supply projects, this worksection, as shown on the drawings and Pay items 0310.1 to 0310.5 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:
- Concrete payment rates: At the scheduled rates provided the concrete meets the strength requirements shown in the Concrete strength requirements table or as otherwise documented.
- Reduction in payment rates: Where any concrete does not reach the strength specified in the Concrete strength requirements table, at the scheduled rate of payment reduced by 2% for each 1%, or fraction thereof, by which the strength of the specimen fails to reach the specified strength, up to a maximum deficiency of 10%.
- Rejection: If the deficiency in strength exceeds 10%, the concrete represented by the specimens may be rejected, in which case no payment will be made for the work nor for any remedial work to rectify the deficiency.
## Pay items table

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>0319.1 Excavation</td>
<td>m³, measured in bank volume of excavation</td>
<td>This pay item applies to works included in pay items 0310.2 and 0310.3.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Include in the rate for excavation:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Excavation and backfilling of all types of materials, with no separate rates for earth and rock.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The disposal of surplus material</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The control of stormwater runoff.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Do not include:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Drying out wet excavated material or replacement of over excavation beyond the design cross-sectional</td>
</tr>
<tr>
<td></td>
<td></td>
<td>limits defined above.</td>
</tr>
<tr>
<td>0319.2 Footpaths, driveways, median toppings and</td>
<td>m², measured as the horizontal surface area</td>
<td>Include all operations involved in the forming and compaction of foundations, subbase, concreting,</td>
</tr>
<tr>
<td>works of similar nature</td>
<td>of the concrete footpath, driveways, median</td>
<td>finishing, curing and backfilling.</td>
</tr>
<tr>
<td></td>
<td>topping, or similar as constructed</td>
<td>Where specified on the Drawings, include the supply and placement of reinforcing steel.</td>
</tr>
<tr>
<td>0319.3 Sprayed concrete</td>
<td>m² of sprayed concrete in place</td>
<td>Include all the operations involved in the surface preparation, spraying, jointing, removal of splash</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and rebound material, curing and testing.</td>
</tr>
<tr>
<td>0319.4 20 MPa Concrete for miscellaneous minor</td>
<td>m³ of concrete supplied and placed</td>
<td></td>
</tr>
<tr>
<td>concrete work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0319.5 32 MPa Concrete for miscellaneous minor</td>
<td>m³ of concrete supplied and placed</td>
<td></td>
</tr>
<tr>
<td>concrete work</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 7 ANNEXURE A

#### 7.1 SELECTIONS

**Aggregate property schedule**

<table>
<thead>
<tr>
<th>Aggregate property</th>
<th>Tests</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water absorption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Formed surface finishes schedule**

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>A</td>
</tr>
<tr>
<td>Surface finish class to AS 3610.1</td>
<td></td>
</tr>
<tr>
<td>Form lining type</td>
<td></td>
</tr>
<tr>
<td>Colour control</td>
<td></td>
</tr>
<tr>
<td>Bolt hole filling</td>
<td></td>
</tr>
<tr>
<td>Surface finish type</td>
<td></td>
</tr>
</tbody>
</table>
## Concrete properties schedule – performance

<table>
<thead>
<tr>
<th>Type</th>
<th>Normal and special class</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air entrainment – air volume (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum aggregate size (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment process</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slump (mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strength grade/characteristic compressive strength (MPa)</td>
<td>Refer to the Concrete strength requirements table.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Special class

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleeding (mL/mm²)</td>
<td></td>
</tr>
<tr>
<td>Cement type</td>
<td></td>
</tr>
<tr>
<td>Density of hardened concrete (kg/m³)</td>
<td></td>
</tr>
<tr>
<td>Density of plastic concrete (kg/m³)</td>
<td></td>
</tr>
<tr>
<td>Drying shrinkage</td>
<td></td>
</tr>
<tr>
<td>Duration of air drying</td>
<td></td>
</tr>
<tr>
<td>Early age strength (MPa)</td>
<td></td>
</tr>
<tr>
<td>Flexural strength (MPa)</td>
<td></td>
</tr>
<tr>
<td>Indirect tensile strength (MPa)</td>
<td></td>
</tr>
<tr>
<td>Mineral oxide content</td>
<td></td>
</tr>
<tr>
<td>Mix type</td>
<td></td>
</tr>
<tr>
<td>Water:cement ratio maximum</td>
<td></td>
</tr>
<tr>
<td>56 day shrinkage strain tested to AS 1012.13</td>
<td></td>
</tr>
</tbody>
</table>

## Control tests schedule

<table>
<thead>
<tr>
<th>Concrete element</th>
<th>28 day strength</th>
<th>Transfer strength (MPa)</th>
<th>Days after pouring</th>
<th>Early strength (MPa)</th>
<th>Days after pouring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Minimum time delay schedule

<table>
<thead>
<tr>
<th>Between (pour locations)</th>
<th>Minimum period between adjacent pours (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjacent pours abutting horizontal construction joints in walls</td>
<td></td>
</tr>
<tr>
<td>Adjacent pours abutting vertical construction joints in walls</td>
<td></td>
</tr>
<tr>
<td>Floor slab construction joints</td>
<td></td>
</tr>
<tr>
<td>“Pour strips” and adjacent concrete</td>
<td></td>
</tr>
<tr>
<td>Retaining wall construction joints</td>
<td></td>
</tr>
</tbody>
</table>

## Unformed surface finishes schedule

<table>
<thead>
<tr>
<th>Property</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
</tr>
<tr>
<td>Location</td>
<td></td>
</tr>
</tbody>
</table>
### 1001 CONTROL OF TRAFFIC

#### 1 GENERAL

**1.1 RESPONSIBILITIES**

**Objectives**
Traffic control: Provide traffic control for works on roads. Construct the work with the least possible obstruction to traffic.

**Performance**
General: Provide the following, as documented:
- Personnel plant and equipment.
- Temporary roadways and detours.
- Arrangement for traffic.
- Traffic control devices.

Requirements: Ensure the safety of workers and safety and convenience of road users at all times.

**Design**

Designer: [complete/delete]

Authority requirements: [complete/delete]

#### 1.2 CROSS REFERENCES

**General**
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Traffic control.
- 1102 Control of erosion and sedimentation.
- 1111 Clearing and grubbing.
- 1112 Earthworks (Roadways).
- 1121 Open drains, including kerb and channel (gutter).
- 1141 Flexible pavement base and subbase.
- 1192 Signposting.
- 1193 Guide posts.
- 1194 Non-rigid road safety barrier system.
- 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:
- AS 1742 Manual of uniform traffic control devices
- AS 1742.3-2009 Traffic control for works on roads
- AS 1742.14-1996 Traffic signals
- AS 1743-2001 Road signs - Specifications
- AS 1744-1975 Forms of letters and numerals for road signs (known as Standard alphabets for road signs)
- AS/NZS 1906 Retroreflective materials and devices for road traffic control purposes
- AS/NZS 1906.1:2007 Retroreflective sheeting
- AS/NZS 1906.4:2010 High-visibility materials for safety garments
- AS 4191-1994 Portable traffic signal systems
- AS/NZS 4192-2006 Illuminated flashing arrow signs
- AS/NZS 4602 High visibility safety garments
- AS/NZS 4602.1:2011 Garments for high risk applications

Other publications
- AUSTROADS AGRD03-2010 Guide to road design - Geometric Design
- AP-R337-09-2009 National approach to traffic control at work sites
- AGTM06-2007 Guide to Traffic management – Intersection, interchanges and crossings

1.4 STANDARDS

General
Standard: To AS 1742.3 and AP-R337/09.

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- TCP: Traffic Control Plan.
- TGS: Traffic Guidance Scheme.

Definitions
General: For the purposes of this worksection the following definitions apply:
Competent person: A person who has, through a combination of training, qualification and experience, acquired knowledge and skills enabling that person to correctly perform a specified task.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

Approvals
- Traffic guidance scheme.
- Statutory approvals from council or other relevant authority.

Drawings
- Temporary roadways and detours.
- Signpost layout plan.
- Pavement marking details.

Execution details
- Schedule of working times.
Notice
General: Give notice so that the documented inspection and submissions may be made to the HOLD POINT table and the WITNESS 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>Traffic guidance scheme</td>
<td>Approval of Traffic guidance scheme</td>
<td>4 weeks before proposed commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Traffic guidance scheme</td>
<td>Approvals from Council and other Authorities for Temporary traffic arrangement</td>
<td>4 weeks before proposed commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Levels of Traffic Guidance Schemes</td>
<td>Carry out a risk assessment for works not involving complex traffic arrangements or staged works or both</td>
<td>4 weeks before proposed commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
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</tr>
<tr>
<td>Side roads and property accesses - Access</td>
<td>Proposal for access</td>
<td>5 working days prior to carrying out works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Side roads and property accesses – Notice to property owners</td>
<td>Approval to deny vehicular access and provide notice to property owners</td>
<td>3 working days prior to carrying out works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Plant and equipment – Inadequate traffic control devices</td>
<td>Rectify non conforming traffic control devices</td>
<td>1 working day of notice</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Opening to traffic – Opening temporary road ways and detours to traffic</td>
<td>Redirection onto existing roadway in the event of failure</td>
<td>1 working day</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Opening to traffic – Opening temporary road ways and detours to traffic</td>
<td>Inspect and approve all roadways and detours prior to opening</td>
<td>2 working days prior to carrying out works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Opening to traffic – Opening completed work</td>
<td>Written notice and procedure for road opening</td>
<td>5 working days prior to carrying out works</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>
### WITNESS POINTS table – On-site activities

<table>
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<tr>
<th>Clause/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRE-CONSTRUCTION PLANNING</strong></td>
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<td></td>
</tr>
<tr>
<td>Traffic Guidance Scheme</td>
<td>Site copy of TGS</td>
<td>Progressive</td>
</tr>
<tr>
<td>Safety Audit</td>
<td>For complex traffic arrangements and staged works carry out safety audits</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barriers and fencing – Boom gates</td>
<td>Provide if requested</td>
<td>Prior to commencing works</td>
</tr>
<tr>
<td>Barriers and fencing – Cones and bollards</td>
<td>Restrictions for use of cones when attended by an employee.</td>
<td>Progressive</td>
</tr>
<tr>
<td>Temporary markings – Line marking</td>
<td>Ineffective line marking, remark within 48 hours.</td>
<td>Progressive</td>
</tr>
<tr>
<td>Temporary markings – Old markings</td>
<td>Obliterate or remove old markings.</td>
<td>Progressive</td>
</tr>
<tr>
<td>Temporary markings – Raised Pavement markers</td>
<td>Replace ineffective markers within 24 hours.</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personnel - Traffic controllers</td>
<td>Submit names and declaration of proposed traffic controllers</td>
<td>Prior to commencing work</td>
</tr>
<tr>
<td>Personnel - Traffic controllers</td>
<td>Additional traffic controller required where sight distance is restricted</td>
<td>Progressive</td>
</tr>
<tr>
<td>Personnel - Night and poor light</td>
<td>Flood light as required.</td>
<td>Progressive</td>
</tr>
<tr>
<td>Plant and equipment – Temporary speed zoning</td>
<td>Diary and method of works</td>
<td>Progressive</td>
</tr>
<tr>
<td>Plant and equipment – Arrangement and placement of traffic control devices</td>
<td>To the approved TGS</td>
<td>Progressive</td>
</tr>
<tr>
<td>Temporary roadways and detours - Drainage</td>
<td>Pavement drainage construction</td>
<td>Progressive</td>
</tr>
<tr>
<td>Temporary roadways and detours – Wearing surface</td>
<td>Width of wearing surface and position of finish tying into existing works</td>
<td>3 working days prior to carrying out works</td>
</tr>
<tr>
<td>Temporary roadways and detours – Construction under traffic</td>
<td>Approval required to construct under traffic</td>
<td>3 working days prior to carrying out works</td>
</tr>
<tr>
<td>Temporary roadways and detours – Construction under traffic</td>
<td>Prior notice of work commencing under traffic</td>
<td>5 working days prior to carrying out works</td>
</tr>
<tr>
<td>Opening to traffic – Opening temporary roadways and detours to traffic</td>
<td>Traffic switch requires workers on site for a minimum of 2 working days</td>
<td>2 working days</td>
</tr>
<tr>
<td>Opening to traffic – Maintain temporary roadways and detours</td>
<td>Ensure safe surface for traffic</td>
<td>Progressive</td>
</tr>
</tbody>
</table>
PRE-CONSTRUCTION PLANNING

2.1 TRAFFIC GUIDANCE SCHEME

General
Requirement: Submit a traffic guidance scheme for approval at least 4 weeks prior to proposed commencement on site. The Traffic guidance scheme must include both the traffic management plan and the Traffic control plan. The Traffic Guidance scheme must be prepared by a competent person. Where the control of traffic does not require pavement or drainage works the period of notice will be 2 weeks. This is a HOLD POINT.

Obtain: All necessary approvals from Councils and other authorities for temporary traffic arrangements. This is a HOLD POINT.

Site copy: Keep an approved copy of the Traffic Guidance Scheme on site at all times. This must be used to check the arrangement and maintenance of traffic control devices. This is a WITNESS POINT.

Level of Traffic guidance schemes
Levels: For traffic guidance schemes conform to the following:
- a) Short term and mobile works not involving full or part road closure.
- b) Works involving relatively simple part-roadway closures.
- c) Works involving complex traffic arrangements or staged works or both.

Risk assessments: Carry out for (a) and (b) considering factors such as traffic volume and speed, road geometry and width and the general behaviour of road users. If the risk can not be tolerated a fully protected work site will be required. This is a HOLD POINT.

Traffic Management Plan
Include: The Traffic Management Plan must include the following:
- Design drawings for any temporary roadways and detours to conform with Design drawings showing pavement, wearing surface and drainage details.
- Details of arrangements for construction under traffic.
- Traffic Control Plan(s).
- Vehicle Movement Plan(s) – Planning for movement of work vehicles including deliveries, personnel and contractors and gang trucks.
- Application for temporary speed zoning changes.
- Special consideration to the safety of the workers, pedestrians, cyclists.
- Names, addresses and means of communicating with personnel nominated for contact outside normal working hours to arrange for adjustments or maintenance of traffic control devices and temporary roadways and confirmation that this list has been supplied to the local Police.

Traffic Control Plan
- Include: The Traffic Control Plan must include the following:
- A proposal to erect a Regulatory Traffic Control Device showing locations and times of operation.
- Appropriate temporary speed zoning signs.
- Boom gates.
- Portable traffic signals.
- Temporary fixed traffic signals.
- A signpost layout plan showing:
  - Location, size and legend of all temporary signs.
  - Temporary regulatory signs and temporary speed zones.
  - All traffic control devices such as temporary traffic signals, linemarking, pavement reflectors, guideposts, guardfence and barrier boards.
- Working times when traffic control measures are in place to minimise disruption to traffic during periods of peak flows.
- Take particular care when requiring reversal of traffic flows or the separation of unidirectional flow by medians or other physical separation.
Safety Audit
Audit: Conduct a safety audit for the construction phase as recommended in AGRS 06-09 for complex traffic arrangements and staged works. This includes risk assessments for the workers safety. This is a **WITNESS POINT**.

2.2 DESIGN

Design standards
Standard alignment and grading: Adopt the specific provisions of this worksection, AUSTROADS AGRD03, **LMCC** design standards.
Intersections: Design intersections to AUSTROADS AGTM06.
Road safety: Conform with documentation on road safety to AGRS 06-09.

Design drawings
Requirement: Submit design drawings for approval that show:
- Alignment and grading at a horizontal scale of 1:2000 for rural roads and 1:500 for urban roads. Where the temporary road rejoins the existing road, extend levels showing the full cross section along the existing road for a minimum length of 200 m.
- A sight distance diagram if opposing traffic is to use a single carriageway.
- Intersections, and any other locations where traffic may be required to make turning, merging or diverging movements, at a scale of 1:500.
- Pavement marking details.
- Sufficient cross-sections to indicate the feasibility of making connections between various parts of the work.
- Sufficient dimensions, especially lane widths, to make clear the geometry and clearances of the proposed Works.
- A north point or some other location method to orientate the plan.
- Pavement type and surface type.
- Roadside furniture.
- Drainage culverts and pits.

Design parameters
- **Design travel speed (km/hr)**: [complete/delete]
- **Minimum widths of traffic lanes (m)**: [complete/delete]
- **Minimum width of shoulders (m)**: [complete/delete]
- **Minimum width of shoulder seal (m)**: [complete/delete]
- **Wearing surface**:
  - **Minimum surface type**: [complete/delete]
  - **Minimum thickness (mm)**: [complete/delete]
- **Base**:
  - **Type**: [complete/delete]
  - **Minimum thickness (mm)**: [complete/delete]
- **Sub-base**:
  - **Type**: [complete/delete]
  - **Minimum thickness (mm)**: [complete/delete]

Signage
Signing: Careful considerations must be given to the signing of the work site regardless of the occupation time of the site. This includes:
- Protection of workers.
- Provision of adequate warning of changes in surface condition and the presence of personnel or plant engaged on the road.
- Adequate instruction of road users and their guidance safely through, around or past the work site.
3 MATERIALS

3.1 SIGNS

Specifications
Selection of signs: To AS 1742.3.
Design and manufacturing of signs: To AS 1743.
Details of each letter: To AS 1744.
Reflective material: Class 1 material complying with AS 1906.1.
Sign size: To AS 1742.3, AS 1743 and Annexure.
Signs for night work: Floodlit if outside of the car headlight beams to AS 1742.3.
Flashing arrow signs: To AS/NZS 4192 and installed to AS 1742.3.

Supplementary signs
Annexure: Signs supplementary to AS 1742.3 and AS 1743.
Use: In lieu of or in addition to those shown in AS 1743 as follows:
- Heavy machinery crossing temporary sign SW5-22 in lieu of trucks entering sign W5-22.
- Cycle hazard grooved road temporary sign ST1-10 in addition to T1-10 where the road is
grooved and is a hazard to cyclists.
- Tar spraying possible short delay temporary sign ST3-1 in addition to T3-1 for bituminous
surfacing works.
- Changed traffic conditions ahead temporary sign ST1-6 in addition to T1-1, T1-6, T2-6 and T2-
21 on long term works, sidetracks and detours.

3.2 BARRIERS AND FENCING

Barrier boards
Standard: To AS 1742.3.
Size: 150 to 200 mm high, 4 m maximum length.
Colour: Alternate diagonal stripes of black and retroflective yellow terminating in yellow at each
end.
Retroreflective sheeting: Minimum Class 1 to AS/NZS 1906.1.
Placement: Do not place parallel to the direction of traffic flow.
Support: Mount on trestles or fixed posts at about 1 m above the pavement.
Support Material: Timber, metal or other suitable material.
Support Colour: Yellow.
Stability: Provide concrete blocks, sandbags or other approved devices to ensure barriers are
stable.
Bases: Keep the bases of the trestles within the ends of the boards.

High visibility flexible mesh fencing
Standard: To AS 1742.3.
Height: Approximately 1 m.
Colour: Orange.
Support: Top of the fence is at least 800 mm above ground level at all times.
Posts: Use temporary post-mounted delineators.
Location: Erect parallel to and in close proximity to traffic.

Boom gates
Type and location: As requested by the Superintendent or Local Roads Authority. This is a
WITNESS POINT.

Cones and bollards
Standard: To AS 1742.3.
Cones: Fluorescent red or orange material resilient to impact.
Small cones: Used in most built up areas, footpaths, shared paths, and speeds < 70 km/hr. 450 to
500 mm high.
Large cones: Minimum 700 mm high all other locations or instead of the small cones.
Spacing: To AS 1742.3 and all purposes with speed limit less then 50 km/h maximum spacing
4 m.
Bollards: Vertical tube fluorescent red or orange material resilient to impact. At least 750 mm high
and 100 mm diameter.
Placement: Locate traffic cones and bollards to AS 1742.3.
3.3 TEMPORARY MARKINGS

Pavement reflectorised markings
Pavement markings: Include painted lines, roadmarking tape and raised pavement markers.
Standard: To AS 1742.3.
Edgelining: Where the adjoining roadway is edgelined, provide edgelining to temporary roadways.
Linemarking
Type: Pavement marking tape.
Maintenance: If the pavement linemarking becomes ineffective remark within 48 hours of direction by the Superintendent. This is a WITNESS POINT.

Arrows
Location: If single carriageway is opened adjacent to or in lieu of an existing dual carriageway length.
Place: Pavement arrows indicating the direction of flow of traffic at not more than 500 m.
Remove: Arrows if the section is then reincorporated as dual carriageway.

Old markings
Removal: Obliterate or remove all superseded pavement markings immediately before, or after placement of, new markings. Do not obliterate by painting on a final surface. This is a WITNESS POINT.

Raised pavement markers
Ineffective markers: Replace raised pavement markers which have become ineffective, within 24 hours of direction by the Superintendent. This is a WITNESS POINT.

3.4 TRAFFIC SIGNALS

Portable traffic signals
Standard: To AS 4191.
Use: Short term applications of shuttle control where a single lane has to be used alternately by traffic from opposite directions or at road crossings or intersections.

Temporary fixed traffic signals
Design and installation of temporary fixed traffic signals: To AS 1742.14.
Use: Longer term shuttle operations or for non-shuttle control of intersecting traffic flows.

Traffic warning lamps
Installation: To AS 1742.3.
Maintain: In good working order, correctly aligned and positioned with respect to the direction of traffic flow each night, before the site is left unattended.

4 EXECUTION

4.1 SIDE ROADS AND PROPERTY ACCESSES

Access
Passage: At all times provide safe and convenient passage for vehicles, pedestrians and stock to and from side roads and property accesses connecting to the roadway.
Alternative access: Submit proposal for approval prior to commencing the work affecting access. This is a HOLD POINT.

Notice to property owners
Denial of vehicular access: Where access needs to be denied due to particular construction activities undertake the following:
- Obtain the approval the of the Superintendent.
- Advise the property owners of such occurrences by way of letter drop at least 24 hours prior to such an interruption.
- Repeat this advice verbally to the property owner in a courteous manner.
- Keep these interruptions to an absolute minimum. This is a HOLD POINT.
4.2 PERSONNEL

Traffic controllers
Standard: To AS 1742.3.
Personnel: Submit names of proposed traffic controllers with a signed declaration that they are appropriately trained in the duties of traffic controllers to AS 1742.3. This is a WITNESS POINT.
Recognition marks: A distinguishing mark on the outer garment of authorised traffic controllers indicating their authority.
Location of traffic controllers: One traffic controller will remain at the head of each traffic queue while it is halted.
Restricted sight distance: An additional traffic controller must be placed at the tail end of the queue. This is a WITNESS POINT.
Two-way radio: Where both ends of the work are not intervisible, use two-way radio for the traffic controller at each end, or an intermediate traffic controller, from whom both other traffic controllers take their cue, is stationed where both can see extremities of the work.

Night and poor light
Wand: Use an illuminated red cone wand (torch) with a minimum capacity of 30,000 candela to control traffic.
Lighting: The traffic controller and the work area adjacent must be illuminated where possible by flood lighting. Position the flood lighting above the work area and direct downwards and incline slightly to illuminate the face of the STOP/SLOW bat. This is a WITNESS POINT.
Flood lighting: Must not create glare for approaching drivers.
Environmental effects: Consider the adverse effects of high lighting levels close to residential property.

Approved clothing for work personnel
Standard: To AS 1742.3, AS/NZS 4602 and AS/NZS 1906.4.
Requirements: All personnel are required to wear a garment or garments of the classification appropriate for the time of work as follows:
- Class D—garments for daytime use only. Red-orange or yellow.
- Class N—garments for night-time use only. Retroreflective strips of White or yellow.
- Class D/N—garments for both day and night use. Red-orange or yellow.
Flammable: Potentially flammable clothing must not be worn close to work likely to generate flame or hot splatter / molten metal.

4.3 PLANT AND EQUIPMENT

Plant delineation
Plant and equipment: When working in a position adjacent to traffic with a projection beyond the normal width of the item, for example, a grader blade. Direct traffic around such plant and equipment as follows:
- Day light conditions: Attach a fluorescent red flag to the outer end of the projection.
- Night or poor light conditions: Provide an additional traffic controller with an illuminated red wand.

Night time Clearance
Remove plant: Where traffic is permitted to use the whole or portion of the existing road, remove all plant items and similar obstructions from the normal path of vehicles
Lateral clearance: At least 6 m where practicable, with a minimum clearance of 1.2 m.
Lamps: Flashing yellow lamps may be used to draw attention to advance signs. Do not use for delineation.

Signs and devices
Conform to the following:
- Must be installed by a competent person.
- Must be appropriate to the conditions at the work site and used to AS 1742.3 unless a competent person has carried out a risk assessment for an alternative arrangement.
- Must be erected before work commences at a work site.
- Regularly check and maintain in a satisfactory condition.
- Remove from the work site as soon as practicable after works complete including stone removal and line marking.
- Keep records of all signing and delineation at roadway or part roadway closures.
- Relocate or reposition traffic control items so they are visible and perform their regulatory function.
- Place 1m clear of the travelled path. For works taking longer than 2 weeks signs must be mounted on poles sunk into the ground and duplicated on the right side of the road if physically possible.

**Temporary speed zoning**

General: Conform to the following:
- Arrange for the supply of appropriate temporary speed zoning signs, including posts and fittings, for erection where a temporary speed limit has been approved by the Local Council Traffic Committee or Road Authority.
- Erect these signs, cover the signs when the speed zone is not in use and remove the signs when the speed zone is no longer required as part of the provision for traffic as directed or approved.
- Keep a diary recording operation times of the speed zone to be made available when requested. This is a WITNESS POINT.

**Arrangement and placement of traffic control devices**

Layout: To the approved Traffic guidance scheme and AS 1742.3. This is a WITNESS POINT.
Cover and/or remove: All temporary traffic control devices when no longer required without delay and maintain unambiguous safe guidance to traffic.
Maintain: All traffic control devices in accordance with AS 1742.3 so that they are in good order and in the correct positions day and night. At all times the signs should be neat, clean, clear and legible.

**Unacceptable traffic control devices**

Do not use: The following items for traffic control:
- Steel drums.
- Isolated or non-continuous barrier units.
- Barrier boards parallel to and within 4m of the direction of traffic flow.

**Inadequate traffic control devices**

Nonconforming traffic control devices: Where the Contractor fails to provide and maintain traffic control devices as specified in this worksection and to conform with the approved Traffic Guidance Scheme and Standards. This is a HOLD POINT.

### 4.4 TEMPORARY ROADWAYS AND DETOURS

**Drainage**

General: Construct drainage structures and drains in accordance with the following worksections:
- 1121 Open drain, including kerbs and channel (gutter).
- 1351 Stormwater drainage.
- 1352 Pipe drainage.
- 1354 Drainage structures.

Design frequency: Provide for run-off due to one in five year ARI rainfall, without overflow affecting the road.
Pavement drainage: Design and construct pavements to prevent water ponding on the wearing surface or shoulders. Construct temporary formations not to dam water. This is a WITNESS POINT.

**Temporary roadways**

General: Construct Temporary roadways in accordance with the following worksections:
- 1102 Control of erosion and sedimentation.
- 1111 Clearing and grubbing.
- 1112 Earthworks (Roadways).
- 1141 Flexible pavement base and subbase.

Temporary kerbing: To conform with:
- Forming temporary medians, traffic islands or pavement edges.
- Height < 150 mm.
- Securely fastened to the pavement.
- Clearly delineate.
- As seen by the approaching traffic the width must be in a continuous line of 150 mm.
- Conform to 1121 Open drains, including kerb and channel (gutter).

**Wearing surface**

General: Construct surfacing to conform with the worksections:
- 1143 Sprayed bituminous surfacing, and/or
- 1144 Asphaltic concrete (Roadways).

Quality: Firm, even and skid resistant under all weather conditions and designed to remain sound during use.

Width of the wearing surface: As shown on the drawings or width of the traffic lanes plus the width of each shoulder. This is a WITNESS POINT.

Tie-in to existing work: Carry the wearing surface onto any existing connecting roadway so as to finish square to the existing roadway centreline. This is a WITNESS POINT.

**Road safety barrier**

Location: On all temporary embankments where the vertical height between the edge of the shoulder and the intersection of the embankment slope and natural surface exceeds 2 m and as otherwise documented.

Type: Corrugated steel or precast concrete safety barriers.

Erection: To conform with the following:
- 1163 Rigid road safety barrier systems.
- 1194 Non-rigid road safety barrier systems.

**Construction under traffic**

Situation: Where a temporary roadway or a detour is not provided or available then construction under traffic is permitted provided the minimum widths are achieved. This is a WITNESS POINT.

Minimum widths: Conform to the following:
- Through traffic on a two lane roadway a minimum of one 3.5 m lane width.
- Multilane roads minimum 3.5 m lane width in both directions.

Carriageway restoration: To a safe and trafficable state for through traffic prior to ceasing work each day.

Prior notice of work: Notify the Superintendent of the arrangements and methods for traffic control at least five working days before undertaking any work which would involve construction under traffic. This is a WITNESS POINT.

### 4.5 OPENING TO TRAFFIC

**Opening temporary roadways and detours to traffic**

Program: Complete all signposting, pavement marking, guard fence and portable or temporary traffic signals before the opening of temporary roadways to traffic.

Traffic switch: To a temporary roadway or detour must only occur where the Contractor’s usual workforce will be on site for a minimum of two days thereafter. This is a WITNESS POINT.

Arrange: The opening of temporary roadways so that sections of existing roadway being replaced are not disturbed for a minimum of forty-eight hours.

Roadway failure: In the event of temporary roadway failure direct the traffic back onto the existing roadway. This is a HOLD POINT.

Inspection: Do not open temporary roadways and detours (including portable or temporary traffic signals sites) to traffic until they have been inspected and approved in writing. This is a HOLD POINT.

Partial completion: The use of the completed Works or part of the Works in providing for traffic is not considered as full opening to traffic and not a reason for payment under the completion of the works.

Maintain: Temporary roadways and detours and ensure the road surface is kept safe for traffic. Repair any potholes or other failures without delay. This is a WITNESS POINT.

**Opening completed work**

Prior notice: Provide the Superintendent with at least five working days written notice confirming the date of opening completed work to traffic. Determine the procedure for opening through consultation with the Superintendent and local Police. This is a HOLD POINT.

Complete: All permanent signposting, pavement markings, guard fence and traffic signals relevant to the completed work under the Contract prior to opening completed work to traffic.

Remove: All temporary traffic control devices no longer required for the safety of traffic, when the Works or part thereof are opened to traffic.
5 MEASUREMENT AND PAYMENT

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 1101.1.
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:

- Drainage is measured and paid in accordance with:
  - 1121 Open drain, including kerbs and channel (gutter).
  - 1351 Stormwater drainage.
  - 1352 Pipe drainage.
  - 1354 Drainage structures.

- Temporary roadways and detours is measured and paid in accordance with:
  - 1102 Control of erosion and sedimentation.
  - 1111 Clearing and grubbing.
  - 1112 Earthworks (Roadways).
  - 1121 Open drain, including kerbs and channel (gutter).
  - 1141 Flexible pavement base and subbase.

- Wearing surface is measured and paid in accordance with:
  - 1143 Sprayed bituminous surfacing, and/or
  - 1144 Asphaltic concrete (Roadways).

- Road safety barriers is measured and paid in accordance with:
  - 1163 Rigid road safety barrier systems.
  - 1194 Non-rigid road safety barrier systems.

All activities for the construction, maintenance and removal of temporary roadways, including side-tracks and divided road crossovers, and detours detailed in this worksection, to the requirements of specific activity worksections parts, are measured and paid in accordance with those worksections parts.

5.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule Rate scope</th>
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</thead>
<tbody>
<tr>
<td>1101.1 Control of traffic</td>
<td>Lump Sum item</td>
<td>All costs associated with:</td>
</tr>
<tr>
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<td>- All documentation and approvals:</td>
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<td>- The design of temporary roadways and detours, traffic switching operations, the</td>
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<td>provision of traffic controllers (as specified), signposting,</td>
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<td>roadmarkings, raised pavement markers, lights, barriers. and</td>
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<td>- Any other traffic control devices required for the safe movement of traffic</td>
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<td>and the protection of persons and property in accordance with this worksection.</td>
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<tr>
<td></td>
<td></td>
<td>- Progress payments to be</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>made on a pro-rata basis of work done under this item, having due regard to the duration of the Contract.</td>
</tr>
</tbody>
</table>

### 6 ANNEXURES

#### 6.1 SUPPLEMENTARY TEMPORARY WARNING SIGNS IN ADDITION TO AS 1743 AND AS 1742.3.

![Sign SW5-22](image)

Dimensions are in mm
Colours: Black letters and border on yellow reflectorised ground.
Sign SW5-22

![Sign SW5-22](image)

Dimensions are in mm
Colours: Black letters and border on yellow reflectorised ground.
Sign ST1-10

Dimensions are in mm
Colours: Black letters and border on yellow reflectorised ground.

Sign ST3-1

Dimensions are in mm
Colours: Black letters and border on yellow reflectorised ground.

Sign ST1-6
1102 CONTROL OF EROSION AND SEDIMENTATION (CONSTRUCTION)

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide the works and implement measures to control erosion and sedimentation, as documented and in accordance with the approved Environmental Management Plan.

Performance
Requirements: [complete/delete]

Design
Requirements: Design the control measures for erosion and sedimentation to comply with statutory requirements. Preclude any potential hazard to persons or property.
Designer: [complete/delete]
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0257 Landscape – roadways and street trees.
- 1101 Control of traffic.
- 1111 Clearing and grubbing.
- 1112 Earthworks (Roadways).
- 1121 Open drains, including kerb and channel (gutter).

1.3 REFERENCED DOCUMENTS

The following documents are incorporated into this worksection by reference:
Institute of Public Works Engineering Australia (IPWEA)

1.4 STANDARDS

The following documents are incorporated into this worksection by reference:
Documents: [complete/delete]

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
CEMP: Environmental Management Plan.
ESCP: Erosion and Sediment Control Plan.
NTU: The units of turbidity from a calibrated nephelometer are called Nephelometric Turbidity Units.
SWMP: Soil and Water Management Plan.

Definitions
General: For the purposes of this worksection the following definitions apply:
- Erosion: The wearing away of land by the action of rainfall, running water, wind, moving ice or gravitational creep. Soil detachment (erosion) occurs when the erosive forces exceed the soil's resistance, causing the soil particles to move.
- Sediment: Sediment is the result of erosion, and consists of small detached soil particles. It occurs when the transportation of detached soil particles ceases or slows and the soil particles fall out of suspension.
1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

Documents
- Contractors Environmental Management Plan (CEMP).
- Soil and Water Management Plan (SWMP).
- Erosion and Soil Control Plan (ESCP).
- Program for coordination of work schedules including order of works and timing.

Drawings
- Access and haulage tracks.
- Borrow pits and stock areas.
- Compound areas.
- Features of the site.
- Relevant construction details.

Calculations
- Survey of embankments.

Manuals: [complete/delete]
Technical data: [complete/delete]
Type tests: [complete/delete]
Type test results: [complete/delete]
Prototypes: [complete/delete]
Samples: [complete/delete]
Warranties: [complete/delete]

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>PRE-CONSTRUCTION PLANNING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractors Environmental Management Plan (CEMP) - General</td>
<td>Submit CEMP with detailed section plans for each catchment area and site section</td>
<td>7 days before site disturbance on each section</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion and sedimentation control measures - Stockpile sites</td>
<td>Proposed stockpile locations</td>
<td>7 days before site disturbance or material delivery</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Earthworks – Embankments and sediment removal</td>
<td>Survey information for volume measurement</td>
<td>3 working days before embankment construction or sediment removal</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>

WITNESS POINTS table

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection by the Superintendent</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Erosion and sedimentation control measures - Control measures</td>
<td>Diversion and catch drains - constructed and lined before the adjacent ground is</td>
<td>3 working days before ground disturbance</td>
</tr>
</tbody>
</table>
## Control of erosion and sedimentation (Construction)

### 2 PRE-CONSTRUCTION PLANNING

#### 2.1 CONTRACTORS ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

**General**
- Minor works: Prepare a CEMP covering erosion and sedimentation control.
- Major works: Prepare a SWMP including both CEMP and ESCP.

**Approval criteria:** [complete/delete]

Site sections: At least seven days before the natural surface is disturbed on each of these sections, submit a CEMP for that section. Superimpose the plan on the drainage drawings of the works. This is a **HOLD POINT**.

Responsibility: The Contractor has the responsibility to provide whatever measures are required for the effective erosion and sedimentation control at all times.

**Responsibilities**
- Adherence: Adhere to the approved CEMP. Submit a revised CEMP for approval seven days in advance of an intended variation from the approved plan.
- Salinity prevention: In known salt affected areas, seek advice from the relevant land and water resource authority to ensure that the proposed CEMP conforms to the current salinity prevention measures outlined in the IPWEA publication, *Local Government Salinity Management Handbook*.

**Minimising erosion**
- Objective: To minimise the quantity of soil lost during construction due to land clearing and earthworks.
- Content: Provide documentation and program scheduling to address the following:
  - Minimum land clearance, particularly of areas of highly erodible soils and steep slopes prone to water and wind erosion.
  - Progressive revegetation and mulching, as each site section is complete.
- Coordination of work schedules for multiple contractors, to avoid delays resulting in disturbed land remaining unstabilised.
- Time schedules for the construction of structures and the implementation of measures to control erosion and sedimentation. Where possible, program the work to avoid seasonal intense rain storms.
- An order of works based upon construction and stabilisation of all culverts and surface drainage works, at the earliest practical stage.
- A Time schedule to address HOLD POINTS and WITNESS POINTS.

Documentation: Implement ahead of, or in conjunction with clearing and grubbing operations (as required by 1111 Clearing and grubbing) all permanent and temporary erosion and sedimentation control measures, including the control measures.

Site sections: For implementation divide the site into sections based on the catchment area draining to each permanent drainage structure in the works and based on the area bounded by the road reserve. Site section information: Provide diagrams indicating the following:
- Access and haulage tracks.
- Borrow pits and stockpile areas.
- Compound areas, such as Contractor’s facilities and concrete batching areas.
- Features of the site, including contours and drainage paths.
- Relevant construction details of all erosion and sedimentation control structures.

2.2 SOIL AND WATER MANAGEMENT PLAN - SUPPLEMENT

General
Objective: To minimise the generation of contaminated stormwater.

Content: Provide documentation to address the following:
- Minimising the quantity of uncontaminated stormwater entering cleared areas.
- Establishing cut-off or intercept drains to redirect stormwater away from cleared areas and sloping to stable (vegetated) areas or effective treatment installations.
- Reducing water velocities.

Preparation
Expertise: Employ an experienced consultant to design, document and technically report on the implementation of the plan and submit details of experience.

Environmental assessment: Identify and obtain information on any relevant environmental impact that may be caused by the works.

Risk assessment: Identify and quantify risks and remedial action that may arise from the construction of the works.

Sediment controls
Objective: To minimise the impact of contaminated water on receiving waters.

Content: Provide documentation to address the following:
- Installing erosion and sediment control measures before construction where possible.
- Identifying drainage lines and install control measures to handle predicted stormwater and sediment loads generated in the mini catchment.
- Designing erosion and sediment run-off control measures appropriate to the site conditions to handle storm events with 2 year ARI with intensity of 6 hours, for temporary structures, and 50 year ARI, for permanent structures.
- Preparing an inspection, maintenance and cleaning program for sediment run-off control structures.
- Creating contingency plans for unusual storm events.
- Planning for the continual assessment of the effectiveness of sediment control measures.

De-watering work sites
Objective: To ensure that de-watering operations do not result in turbid water entering natural waterways.

Content: Provide documentation to address the following with regard to de-watering by pumping:
- Treating contaminated water if the turbidity exceeds 30 NTU.
- Only pump water into natural waterways that does not exceed regulatory water quality standards.
- Pumping water, wherever practical, to vegetated areas of sufficient width to remove suspended soil, or to sediment control structures.
- Monitoring turbidity hourly, if discharge is to a natural waterway.

**Dust control**
Objective: To ensure there is no health risk or loss of amenity due to emission of dust to the environment.
Content: Provide documentation to address the following:
- Suppressing dust by watering.
- Installing wind fences.

**Management of stockpiles and batters**
Objective: To manage soil stockpiles so that dust and sediment in run-off are minimised.
Content: Provide documentation to address the following:
- Minimising the number of stockpiles, and the area and the time stockpiles are exposed.
- Separating soil and overburden stockpiles.
- Locating stockpiles away from drainage lines, at least 10 m away from natural waterways and where least susceptible to wind erosion.
- Designing stockpiles and batters with slopes no steeper than 2H:1V.
- Stabilising stockpiles that will remain bare for more than 28 days by covering with mulch, anchored fabrics or seeding with sterile grass.
- Establishing sediment controls around unstabilised stockpiles and batters.

**Working in waterways and floodplains**
Objective: To minimise stress on aquatic communities when working in a waterway.
Content: Provide documentation to address the following:
- Planning in-stream works to minimise contact time.
- Establishing special practices to minimise impacts on the waterway and disturbance of the banks.
- Stabilising the banks and the in-stream structures so they do not contribute to the sediment load.
- Maintaining minimum flows to ensure the viability of aquatic communities. Ensure the free passage of fish.
- Designing crossings that do not contribute to the sediment load.
- Preparing a contingency plan for severe rainfall events.
- Preparing a reinstatement plan for work in a stream that could alter the waterway structure.

### EXECUTION

#### 3.1 PROVISION FOR TRAFFIC

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

#### 3.2 EROSION AND SEDIMENTATION CONTROL MEASURES

**Control measures**
Construction: To the CEMP and the drawings.
Requirement: Provide erosion and sedimentation control measures to include, but not limited to, the following:
- The installation of permanent drainage structures before the removal of topsoil and before the commencement of earthworks for formation within the catchment area of each structure.
- The prompt completion of all permanent and temporary drainage works, once commenced, to minimise the period of exposure of disturbed areas.
- The construction of diversion and catch drains to divert uncontaminated runoff from outside the site, clear of the site. Construct and line catch drains before the adjacent ground is disturbed and the excavation is commenced. This is a WITNESS POINT.
- To provide for the passage of uncontaminated water through the site without mixing with contaminated runoff from the site.

- The provision of contour and diversion drains across exposed areas before, during and immediately after clearing and the re-establishment and maintenance of these drains during soil removal and earthworks operations.

- The provision of sediment filtering or sediment traps, ahead of and in conjunction with earthworks operations, to prevent contaminated water leaving the site.

- The restoration of the above drainage and sedimentation control works on a day to day basis to ensure that no disturbed area is left without adequate means of containment and treatment of contaminated water.

- The limitation of areas or erodible material exposed at any time to those areas being actively worked. Clearly mark, fence off or otherwise protect any areas not approved for clearing or disturbance. This is a WITNESS POINT.

- The minimisation of sediment loss during construction of embankments by means such as temporary or reverse superelevations during fill placement, constructing berms along the edge of the formation leading to temporary batter flumes and short term sediment traps.

- The progressive revegetation of the site, in accordance with 0257 Landscape - Roadways and street trees.

Stockpile sites
Location: Areas pre-approved for such use.
Protection: Provide a 5 m buffer zone to between stockpile sites and any stream or flow path. Protect all stockpiles from erosion and contamination of the surrounding area by use of the measures approved in the CEMP. This is a HOLD POINT.

Access and exit areas
Decontamination: Include shake-down or other methods approved for the removal of spoil materials from construction plant or vehicles. This is a WITNESS POINT.

3.3 EARTHWORKS
Permanent erosion and sedimentation control basins
Planned levels: Construct earthworks for permanent erosion and sedimentation control basins to the documented levels and dimensions shown on the drawings or such levels and dimensions as determined by the Superintendent.

Site preparation: Clear the entire storage and embankment foundation area of permanent erosion and sedimentation control basins in accordance with 1111 Clearing and grubbing. Strip topsoil and any unsuitable material under embankments to conform with 1112 Earthworks (Roadways).

Embankments and sediment removal
Embankments: To 1112 Earthworks (Roadways).
Survey information: If payment for embankment construction or sediment removal is on a Schedule of Rates basis provide survey information sufficient to subsequently measure the volume of the constructed embankment and sediment removal. This is a HOLD POINT.

3.4 INLETS, SPILLWAYS AND LOW FLOW OUTLETS
Sedimentation control basins and sediment traps
Rock mattresses: Construct inlets and spillways using rock filled woven galvanized steel mattresses and geotextile. Install the rock filled mattresses to conform with the requirements for rock filled wire mattress and geotextile in 1121 Open drains, including kerb and channel (gutter).

Plastic pipe outlet: Install a low flow outlet consisting of a 150 mm diameter plastic pipe in the locations shown on the drawings. No extra payment will be made for this work which forms part of the construction of the sedimentation control basin.

3.5 DROP INLET SEDIMENT CONTROL
Permanent traps
Timing: Construct permanent drop inlet sediment traps and inlet control banks, on completion of gully pits as shown on the drawings. These permanent drop inlet sediment traps and inlet control banks are additional to the temporary sedimentation control measures that may be required during construction of the gully pits.
Purpose: Construct the inlet control banks as required to prevent the surface flows bypassing the gully pits. The drop inlet sediment traps are to remove sediment from the surface flow before it enters the drainage system.

Sediment traps and control banks: Conform to the following:
- Construct the drop inlet sediment traps with the associated inlet control banks to consist of at least two courses of sandbags containing a 10:1 sand/cement mix as shown on the drawings.
- Key the bags at least 25 mm into the surface, dampen sufficiently to ensure hydration of the cement and tamp lightly to provide mechanical interlock between adjacent bags.

3.6 CLEANING

Sedimentation control structures
Timing: Clean out permanent sedimentation control/structures, whenever the accumulated sediment has reduced the capacity of the structure by 50% or more, or whenever the sediment has built up to a point where it is less than 300 mm below the spillway crest. This is a WITNESS POINT.

Pay item criteria: Clean out due to failure to provide or maintain specified erosion Control Measures, will not be included in pay items.

Removal of sediment: Remove accumulated sediment from permanent sedimentation control structures, in such a manner as not to damage the structures.

Disposal: Remove the sediment to a nominated soil stockpile site or dispose in such locations that the sediment will not be conveyed back into the construction areas or into watercourses.

Access: Provide and maintain suitable access to permanent sedimentation control structures, to allow cleaning out in all weather conditions.

Completion
Cleaning: Clean all permanent sedimentation control structures, prior to Practical Completion of the Works.

3.7 TEMPORARY EROSION AND SEDIMENTATION CONTROL

General
Continuous control: Ensure that effective erosion and sedimentation control is provided at all times during the contract. Remove and/or reinstate any temporary or redundant control works at appropriate times during the contract.

Runoff: Prior to dispersing any runoff must be free of pollutants as defined in the relevant legislation. Disperse clean runoff to stable areas or natural water courses.

Control: Provide temporary erosion and sedimentation control measures where the natural surface is disturbed by construction, including roads, depot and stockpile sites. This is a WITNESS POINT.

Maintenance: Provide and maintain slopes, crowns and drains on all excavations and embankments to ensure satisfactory drainage at all times. Do not allow water to pond on the works unless such ponding is part of an approved CEMP.

Control measures
Temporary drains: Control runoff from areas exposed during the work by construction of temporary contour drains and/or temporary diversion drains, which take the form of a channel constructed across a slope with a ridge on its lower side. They may require progressive implementation and frequent alteration as the work progresses.

Contour drains: Provide contour drains across the natural surface at approximately the same elevation. Immediately after a construction site is cleared, intercept and divert runoff from the site to nearby stable areas at non-erosive velocities. Construct as follows:
- Contour drains, as shown on the drawings, formed with a grade of not less than 1% or greater than 1.5% and spaced at intervals of not less than 20 m or greater than 50 m, depending on the erodibility of the exposed soil.

Diversion drains: Provide diversion drains across haul roads and access tracks when such roads and access tracks are identified as constituting an erosion hazard due to their steepness, soil erodibility or potential for concentrating runoff flow, constructed as follows:
- Formed to intercept and divert runoff from the road or track to stable outlets.
- Spacing of diversion drains not greater than that required to maintain runoff at non-erosive velocities.
Temporary sediment traps: Provide devices during construction to remove sediment from runoff flowing from areas of 0.5 ha or more before the runoff enters stormwater drainage systems, natural water courses or adjacent land. This is a WITNESS POINT.

Trash barriers: Provide and maintain trash barriers to prevent debris from entering natural watercourses.

Batter protection: Take all necessary action to protect batters from erosion during the contract. Minimise scour of newly-formed fill batters during and after embankment construction by diverting runoff from the formation away from the batter until vegetation is established.

**Maintenance**

Maintenance and inspection: Inspect all temporary erosion and sedimentation control works after each rain period and during periods of prolonged rainfall. Rectify any defects revealed by such inspections immediately. Clean, repair and augment, as required, the works, to ensure effective erosion and sedimentation control thereafter.

Access: Provide and maintain access from within the road reserve, or from other acceptable locations, for clearing out sedimentation control works. This is a WITNESS POINT.

**Removal**

Timing: Remove all temporary erosion and sedimentation control works when revegetation is established on formerly exposed areas before the end of the contract. Remove from the site or otherwise dispose, all materials and components used for the temporary erosion and sedimentation control works. This is a WITNESS POINT.

### 4 MEASUREMENT AND PAYMENT

#### 4.1 MEASUREMENT

**General**

Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1102.1 to 1102.5 inclusive.

Lump Sum prices: Not acceptable for any item other than Pay Item 1102.1.

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 is measured and paid in accordance with 1111 Clearing and grubbing.
- Landscaping works are measured and paid in accordance with 0257 Landscape – roadways and street trees.
- Topsoil stripping and removal of unsuitable material are measured and paid in accordance with 1112 Earthworks (Roadways).

#### 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>1102.1 Temporary erosion and sedimentation control</td>
<td>Lump sum</td>
<td>All costs associated with the installation, maintenance, inspection and removal of the temporary erosion and sedimentation control measures in accordance with Temporary erosion and sedimentation control inclusive and the drawings.</td>
</tr>
<tr>
<td>1102.2 Earthworks for permanent erosion and sedimentation control basins</td>
<td>m³. The volume will be determined by calculation using the end area method.</td>
<td>All costs associated with compacted embankment constructed in accordance with Earthworks for permanent erosion and sedimentation control basins and the drawings. The schedule rate to cover the excavation of material from within the sedimentation control basin and embankment construction required</td>
</tr>
</tbody>
</table>
### Pay items

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1102.3 Inlets, spillways and low flow outlets for sedimentation control basins</td>
<td>m² of horizontal surface area</td>
<td>All costs associated with the rock filled mattress constructed in accordance with Inlets, spillways and low flow outlets for sedimentation control basins and sediment traps and the drawings.</td>
</tr>
<tr>
<td>1102.4 Drop inlet sediment traps and inlet control banks</td>
<td>‘Each’ drop</td>
<td>All costs associated with drop inlet sediment trap including inlet control bank constructed in accordance with Drop inlet sediment control and the drawings.</td>
</tr>
<tr>
<td>1102.5 Cleaning of permanent sedimentation structures</td>
<td>m³ of in-place sediment</td>
<td>All costs associated with sediment removal from the structure in accordance with Cleaning sedimentation control structures. The volume of sediment removed will be determined by survey or by methods approved by the Superintendent. The schedule quantity is a provisional quantity.</td>
</tr>
</tbody>
</table>
1  GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide clearing and grubbing of vegetation to allow site works for roadway construction to conform with drawings, permits, vegetation clearing schedules as documented.

Performance
Requirements: Provide cleared land, remove and dispose of all rubbish and materials unsuitable for subsequent works as shown on the drawings and directed by the Superintendent.

Requirements: [complete/delete]

Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0257 Landscape – roadways and street trees.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation.
- 1195 Boundary fences for road reserves.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS 1473.1-2000 Wood-processing machinery – safety Part 1: Primary timber milling machinery
AS 1744-1975 Forms of letters and numerals for road signs (known as Standard alphabets for road signs).
AS 4373-2007 Pruning of amenity trees.

1.4 STANDARDS

General
Standard: To AS 4373.

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviation apply:
CTPO: Council’s Tree Preservation Officer.

Definitions
General: For the purposes of this worksection the following definition apply:
- Council: Local Government and/or authority having responsibility for the area to be affected by the works.
- Environmental officer: Council appointed person authorised to determine specific environmental matters.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.
Documents
Submit the following for approval:
- Weed management plan as noted in Pre-construction planning.
- Drawings: Showing area of work completed at the time of each progress claim.
- Calculations: Confirmation of areas or units claimed for ‘Execution.’
- Execution details: Method statements for selective clearing and proposed equipment.
- Technical data: Survey diagrams to record set out results.

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>EXECUTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limits of clearing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey</td>
<td>Decision on the removal of miscellaneous items</td>
<td>7 days before proposed removal</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Extent of clearing</td>
<td>Submit peg out and extent of clearing survey</td>
<td>7 days before proposed commencement of clearing</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Trees to be preserved</td>
<td>Confirm clearing perimeters and mark trees to be preserved</td>
<td>7 days before proposed site clearing</td>
<td>Principal Certifying Authority and CTPO</td>
</tr>
<tr>
<td>Tagging</td>
<td>Work method statement for works within the exclusion zone</td>
<td>7 days before proposed works</td>
<td>Principal Certifying Authority and CTPO</td>
</tr>
<tr>
<td>Work near trees noted for protection</td>
<td>Develop appropriate work methods to avoid damage to the tree for approval</td>
<td>7 days before proposed excavation</td>
<td>Principal Certifying Authority and CTPO</td>
</tr>
<tr>
<td>Excavation within 4m of tree trunks</td>
<td>Direction to remove or protect trees within proposed embankments</td>
<td>7 days before proposed site clearing</td>
<td>Principal Certifying Authority and CTPO</td>
</tr>
<tr>
<td>Trees within proposed embankment areas</td>
<td>Direction on removal of trees or branches not within the clearing limits</td>
<td>7 days before proposed site clearing</td>
<td>Principal Certifying Authority and CTPO</td>
</tr>
<tr>
<td>Unsound trees in road reserve</td>
<td>Written consent of owner to leave in place or to enter property to remove</td>
<td>Prior to carrying out works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Timber falling on private property</td>
<td>Approval for any rehabilitation of vegetation or fauna habitat</td>
<td>3 working days prior to carrying out works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Damage</td>
<td>Explosives not permitted without prior approval</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Grubbing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Disposal of materials

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burning of material</td>
<td>Approval prior to disposal of timber and other combustible materials by burning</td>
<td>Prior to burning</td>
<td>Principal Certifying Authority</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>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existing Utility services - Marking</td>
<td>Locate all underground pipe and cables</td>
<td>Before commencing any earthworks</td>
<td></td>
</tr>
<tr>
<td>Weed control - Procedures</td>
<td>Tag all areas identified in the Weed Management Plan</td>
<td>7 days before commencing works</td>
<td></td>
</tr>
<tr>
<td>Trees to be preserved – Work near trees noted for protection</td>
<td>Exclusion zone around protected trees</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Trees to be preserved – Tree protection</td>
<td>Tree’s and roots not to be cut or damaged</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Grubbing - Backfill</td>
<td>Backfill and compact grub holes</td>
<td>Progressive</td>
<td></td>
</tr>
<tr>
<td>Chipping of cleared vegetation - Stockpiling</td>
<td>Stockpile location approval</td>
<td>Prior to stockpiling</td>
<td></td>
</tr>
</tbody>
</table>

### 2 PRE-CONSTRUCTION PLANNING

#### 2.1 WEED MANAGEMENT PLAN

**Content**
- Identification of weeds and infestation zones within the work site/investigation date.
- Method of cleaning vehicles and machinery, and cleaning date.
- Cleaning bay location and treatment date.
- Contaminated fill stockpile, treatment type and treatment date.

#### 2.2 ESTABLISHMENT

Survey: Provide a qualified survey team to prepare site plans and carry out pegging.
Program: Provide planning resources to allocate plant and personnel for the contract period.
Control measures: In advance or in conjunction with clearing and grubbing operations implement adequate measures in accordance with 1102 Control of erosion and sedimentation.

### 3 EXECUTION

#### 3.1 EXISTING UTILITY SERVICES

**Marking**
Location: Before commencing earthworks, locate and mark existing underground services in the areas to be affected by the works including clearing, excavating and trenching.
Contact: DIAL 1100 BEFORE YOU DIG is a free service, from anywhere in Australia.
Underground pipe and cables are located (possible within two working days). See www.1100.com.au.
Prevent damage: Take all measures to prevent damage to existing underground and overhead utility services. Do not excavate by machine within 1 m of existing underground services. This is a WITNESS POINT.
3.2 LIMITS OF CLEARING

Survey
Submission: Submit a survey plan showing the proposed area for clearing to confirm the clearing perimeters. This is a HOLD POINT.
Pegging: Requirement for pegging includes surveying the areas and locating recovery pegs.

Extent of clearing
Clearing: The areas to be cleared are as shown on the drawings or schedules supplied and areas that will be occupied by:
- The completed Works.
- Erosion and sedimentation measures.
- Stockpile sites and borrow areas.
- A clearance zone of 4 m beyond tops of cuts and toes of embankments where the natural fall of the ground is towards the roadway.
- A clearance zone of 2 m beyond the tops of cuts and toes of embankments where the natural fall of the ground either slopes away from the roadway or is level.

Removal of miscellaneous items: Submit the requirement for any removal of minor miscellaneous items such as minor structures (eg. fences and livestock yards), redundant kerb and gutter, bitumen surfacing, footpaths and driveways, rubbish and any other materials located within the extent of the clearing. This is a HOLD POINT.

Planning and programming: Clearing is to be carried out progressively with only the minimum area of land left disturbed at any time. Ensure that only the absolute minimum area for construction is cleared.

Trees outside limits of work: Plan all operations to ensure that there is no damage to any trees outside the limits of clearing specified or approved.

Natural landscape features: Protect against disturbance any natural rock outcrops, natural vegetation, soil and water courses outside the limits of clearing.

3.3 WEED CONTROL

Procedures
Tagging: Tag areas identified in the Weed management plan. The Superintendent may require additional areas. This is a WITNESS POINT.
Implementation: Avoid spreading weeds during the clearing operations and remove all identified weeds as a separate operation.

Spraying: All persons engaged in spraying to have a current pesticide operator’s licence as issued by the local authority.

3.4 TREES TO BE PRESERVED

Tagging
Inspection: The Superintendent and CTPO will inspect the proposed area for clearing to confirm the clearing perimeters and mark with ribbon markers, or indicate to the Contractor the trees to be preserved or transplanted. This is a HOLD POINT
Program: Implement protective measures before commencement of clearing.

Signage
Warning sign: Display a sign in a prominent position at each entrance to the site, warning that trees and plantings are to be protected during the contract. Remove on completion.
Lettering: Road sign type sans serif letters, 100 mm high, in red on a white background, to AS 1744.

Work near trees noted for protection
Exclusion zone: The area within 4 m of the trunks of trees tagged to be protected is to be an exclusion zone. The following activities must not occur within this zone unless prior approval has been received:
- Erection of structures.
- Excavation and filling.
- Changes to soil profiles.
- Stockpiling of spoil.
- Storage of other materials.
- Driving or parking of any vehicle or machinery.

This is a **WITNESS POINT**

Work method statement: Approval by both the Superintendent and the CTPO is required for works within the exclusion zone of the protected trees. Submit a detailed work method statement involving the protection methods listed in **Tree protection**. This is a **HOLD POINT**.

Harmful materials: Keep the area within the dripline free of sheds and paths, construction material and debris. Do not place bulk materials and harmful materials under or near trees. Do not place spoil from excavations against tree trunks. Prevent wind-blown materials such as cement from harming trees and plants.

**Transplanting**

Method: The lifting and temporary storage of the nominated vegetation for transplanting to conform with **0257 Landscape – roadways and street trees**.

**Excavation within 4 m of tree trunks**

Damage prevention: Submit a work method statement prior to any excavation within 4 m of the trunk of any tree. The work method must avoid damage to the tree and its root system. This work method must be approved by the Superintendent and CTPO. This is a **HOLD POINT**.

Open excavations: Work methods should minimise the time period an excavation is left open under tree canopies.

**Tree protection**

Tree enclosures: Temporary protective enclosures must be 10 times the trunk diameter at 1500 mm measured as a radius from the trunk and may consist of wire, mesh or chain material.

Wire enclosures: Four strands of fencing wire, or plastic mesh barrier, supported on plastic capped star pickets spaced at not more than 4 m.

Mesh enclosures: SL 62 to AS/NZS 4671 reinforcing mesh 1800 mm high wired to 2400 mm long star pickets, driven 600 mm into the ground, spaced 1800 mm apart at a minimum distance of 1 m from the tree trunk.

Chain wire enclosures: 1800 mm high chain wire panels fixed to 40 mm diameter galvanized steel posts.

Trunk protection: If space is not available for tree enclosures provide trunk protection comprising 2000 mm long planks of 100 mm x 50 hardwood stacked vertically around the trunk and secured with 10 gauge wire over hessian protective padding.

Sheeting to excavations: Where excavations are to be made near trees, add continuous 900 mm high corrugated galvanized steel sheeting, bedded 150 mm into the ground, wired to the enclosure.

Damage: Prevent damage to tree bark and root system. Do not attach stays and guys to trees.

**Tree roots**: No tree roots to be cut without prior approval. This is a **WITNESS POINT**.

Work under trees: Do not remove or add topsoil to the area within the dripline of the trees.

Hand methods: Use hand methods to locate, expose and cleanly remove the roots on the line of excavation. If it is necessary to excavate within the drip line, use hand methods such that root systems are preserved intact and undamaged.

Clearing machines: Fit machines used for pushing and heaping operations with root takes or similar and operate to ensure as little soil as possible is removed and heaped with the cleared vegetative material.

Roots: Do not cut tree roots exceeding 50 mm diameter. Where it is necessary to cut tree roots, use means of cutting that do not unduly disturb the remaining root system. Immediately after cutting, water the tree and apply a liquid rooting hormone to stimulate the growth of new roots (e.g. Formula 20® or Hormone 20®).

Backfill material: Backfill around tree roots must be a mixture consisting of three parts by volume of topsoil and one part of well rotted compost. The compost is to have a neutral pH value, free from weed growth and harmful materials.

Compaction of backfill: Place layers of backfill and compact to a dry density similar to that of the original or surrounding soil.

Backfill height: Do not backfill around tree trunks to a height greater than 200 mm above the original ground surface.

Watering: Water trees as necessary, including where roots are exposed at ambient temperature greater than 35°C. Thoroughly water the root zone surrounding the tree immediately after backfilling.

Compacted ground: Do not compact the ground or use skid-steel vehicles under the tree dripline. If compaction occurs, give notice and obtain instructions.
Compaction protection: Protect areas adjacent to the tree dripline, if required submit within the work method statement a proposal for an elevated platform to suit the proposed earthworks machinery.

Mulching: Spread 100 mm thick organic mulch to the whole of the area covered by the drip line of all protected trees.

**Trees within proposed embankment areas**

Notice: Give notice immediately where a tree marked for preservation is located within an area proposed for embankment construction. The Superintendent will decide after approval from the CTPO whether the tree is to be removed or protected. This is a **HOLD POINT**.

Variation to the contract: The cost of protective measures for **Trees within proposed embankment areas** will be paid for as a variation to the Contract.

**Unsound trees in road reserve**

Clearing: Seek approval from CTPO and the Superintendent to clear any unsound tree remaining within the road reserve, but outside the limits of clearing that is likely to fall upon the roadway. This is a **HOLD POINT**.

Pruning: Cut back by hand close to the bole of the tree or main branches, any branch overhanging the road formation to within 0.5 m of the tree trunk to conform with AS 4373.

Disposal: Dispose of any unsound trees and over hanging branches to conform with **Chipping of cleared vegetation**.

Timber falling on private property:
- Prevention: Take every precaution to prevent timber from falling on private property at all times.
- Owners consent: If timber does fall on private property obtain written consent from the property owner for it to remain there or approval to enter the property and remove it for disposal. Submit the owners written consent. This is a **HOLD POINT**.

**Damage**

Restoration: Make good damage of any kind, including damage to trees or fencing, occurring during clearing operations and construction.

Rehabilitation: Any damage caused by the Contractor to vegetation, landforms or fauna habitat must be rehabilitated in consultation with an environmental officer. Restore to the pre-existing condition within the shortest period of time. This is a **HOLD POINT**.

Methods: This may include but is not limited to deep ripping or hand scarifying and raking of wheel tracks and compacted soil, reinstatement of rocks or stones, planting of seeds or seedlings together with subsequent nurturing, repairs to foliage or root systems of trees and shrubs and reinstatement of fauna habitat.

### 3.5 GRUBBING

**General**

Extent of grubbing: All trees and stumps on, or within the limits of clearing which are unable to be felled and removed.

Depth of grubbing: Carry out grubbing operations to a depth of 0.5 m below the natural surface or 1.5 m below the finished surface level, whichever is the lower.

Blasting: Explosives are not permitted for any site activity without prior approval. This is a **HOLD POINT**.

**Backfill**

Backfill holes: To prevent the infiltration and ponding of water immediately backfill holes or depressions remaining after trees and stumps have been grubbed with soil material similar to the adjacent ground. Compact the backfill material to the density of the existing material in the adjacent ground. This is a **WITNESS POINT**.

### 3.6 TREATMENT OF CLEARED VEGETATION

**Milling**

Millable timber: Trim branches to conform with AS 1473.1 any timber species identified for milling. Stack in neat manageable stockpiles in approved locations.

**Fauna habitat**

Large tree trunks: Cut into transportable logs not less than 3.4 m in length and stockpile clear of construction for later placement any tree trunks nominated for salvage as fauna habitat logs.
Wood chip mulch
Prepare: Cut or split to a size to facilitate chipping or incorporation into the existing topsoil as specified all remaining timber that is not for milling or use as fauna habitat logs or for disposal offsite.
Wood-chip mulch: Produce a wood-chip mulch derived from crowns of trees and branches of shrubs cleared under this worksection.
Dimensions of wood-chip mulch: Produce the wood-chip mulch from branches having a maximum diameter of 100 mm and the chipped material produced is not to have two orthogonal dimensions exceeding 75 mm and 50 mm.
Timing: Chip cleared vegetation within 7 days of clearing to avoid excessive drying out of the vegetation and loss of seed stock.

Stockpiling
Landscaping: Stockpile the wood-chip mulch for subsequent use in landscaping to conform with 0257 Landscape – roadways and street trees or for use at other locations as directed. This is a WITNESS POINT.
Mixing: Unless specified otherwise, the mixing of cleared vegetation into the existing topsoil occurs during the topsoil operation s and prior to the removal and stockpiling.
Avoid degradation: Stockpiling operations to ensure that the properties of the cleared vegetation are not degraded and made unsuitable for use in the revegetation works.
Avoid contamination: Stockpiles of vegetation must be free from stones, soil, rubbish and other materials and not be contaminated with matter toxic to plant growth.
Shape: Stockpiles of chipped vegetation 5 m bottom width, 1.5 m high, batter 1 H: 1.5 V.
Weed free: Maintain weed free vegetation stockpile sites for the duration of the stockpiling period. Treat weeds as many times as necessary to control the weed species.
Location: Locate stockpile sites away from drainage lines and position to allow ease of transport of materials at any time. Stockpiles must not impinge on drivers sight lines or affect road safety.
Rehabilitation: Rehabilitate stockpile sites to conform with 0257 Landscape – roadways and street trees.

3.7 DISPOSAL OF MATERIALS

General
Removal from site: Unless otherwise specified elsewhere in this worksection, all materials cleared and grubbed become the property of the Contractor and are to be removed from the site and disposed of legally.
 Burning of disposed material: Approval required for disposal by burning timber and other combustible material. If approved comply with all Statutory Regulations applicable to burning off during the period of the Contract. This is a HOLD POINT.
 Hazard minimisation: Perform any burning off in such a manner that no damage is done to any protected trees or trees outside the limits of clearing. Ensure that smoke resulting from such burning off does not cause a traffic hazard.

4 MEASUREMENT AND PAYMENT

4.1 MEASUREMENT

General
Payments made to the Schedule of Rates: To 0152 Schedule of rates – supply projects, this worksection, the drawings and Pay items 1111.1 to 1111.3 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:
- Erosion and sedimentation control measures are measured and paid in accordance with 1102 Control of erosion and sedimentation (Construction).
- Clearing and grubbing for boundary fencing is measured and paid in accordance with 1195 Boundary fencing for road reserves.
## PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1111.1 Clearing and grubbing</td>
<td>Hectare</td>
<td>All costs associated with all documentation, survey, clearing and grubbing within the plan area bounded by the limits of clearing specified in Limits of clearing.</td>
</tr>
<tr>
<td>1111.2 Removal of trees outside limits of clearing</td>
<td>‘Each’ tree</td>
<td>All costs associated with removal of trees outside the area bounded by the limits of clearing specified in Limits of clearing. The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1111.3 Wood-chipping</td>
<td>‘m³’ in stockpile.</td>
<td>All costs associated with wood-chipping and stock piling the schedule quantity is a provisional quantity.</td>
</tr>
</tbody>
</table>
1112 EARTHWORKS (ROADWAYS)

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide Earthworks for roadways as documented.

Performance
Requirements: Conform to this worksection, the Drawings and Standards as directed and approved.

Design
Designer: [complete/delete]
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0257 Landscape – roadways and street trees.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation (Construction).
- 1111 Clearing and grubbing.
- 1113 Stabilisation.
- 1351 Stormwater drainage (Construction).
- 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:
AS 1289 Methods of testing soils for engineering purposes.
AS 1289.3.3.1-2009 Soil classification tests—Calculation of the plasticity index of a soil.
AS 1289.5.1.1-2003 Soil compaction and density tests—Determination of the dry density or moisture content relation of a soil using standard compactive effort.
AS 1289.5.4.1-2007 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio.
AS 1289.5.7.1-2006 Soil compaction and density tests—Compaction control test—Hilf density ratio and Hilf moisture variation.
AS 2187 Explosives—Storage, transport and use.
AS 2187.2-2006 Use of explosives.
BS 6472 Guide to evaluation of human exposure to vibration in buildings
BS 6472-1-2008 Vibration sources other than blasting
1.4 STANDARD

General
Soil testing: To AS 1289 (Various).

1.5 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Open drains: All drains other than pipe and box culverts and include catch drains, channels (gutters) and kerbs and channels (gutters).
- Rock: Monolithic material with volume greater than 0.5 m$^3$ in sites which cannot be removed until broken up by explosives, rippers or percussion tools. For support purposes material hardness on the Mohr scale $\geq 3$ and not deteriorate on exposure to the atmosphere.
- Selected material zone: The top part of the Upper zone of formation in which material of a specified higher quality is required.
- Topsoil: The surface soil reasonably free from subsoil, refuse, clay lumps, stones and timber fragments.
- Unsuitable material: Material with properties outside the values set out in Annexure A and as determined as unsuitable by the Superintendent.

1.6 SUBMISSIONS

Approvals
- Submissions: To the Superintendent's approval.
- Planning approval for spoil and borrow.
- Permits for access to spoil and borrow locations.

Documents
General:
- Drawings: Work as Executed Drawings.
- Calculations: Survey records, cut and fill calculations.
- Execution details: As documented. Refer to HOLD POINTS, WITNESS POINTS.

Technical data
General:
- CBR tests.
- Proof rolling and deflection monitoring.
- Compaction tests.

Type test results: [complete/delete]

Materials:
- Select materials.
- Synthetic membrane.

Type tests: [complete/delete]

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.

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

© NATSPEC (D08825650)
<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>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment - Protection of earthworks</td>
<td>Replace and/or dry out wet material to minimise any consequent delays to</td>
<td>1 working day prior to next activity</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td></td>
<td>the operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment - Stockpile sites</td>
<td>Approval to use of any stockpile site not shown on the Drawings</td>
<td>3 working days before stockpiling</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Removal of topsoil - Survey</td>
<td>Schedule of surface levels</td>
<td>3 working days before removal</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Cuttings - Ripping floors of cuttings</td>
<td>Submit ripped or loosened material for inspection</td>
<td>Before recompaclion commences</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Cuttings - Compacting floors of cuttings</td>
<td>Inspection of compacted cutting floor</td>
<td>Prior to placing any subsequent layers over the completed cutting floor</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Batter - Variation for batter slopes</td>
<td>Superintendent to order variation if a batter slope is redetermined after completion</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Unsuitable material - Floor inspection</td>
<td>Re-present the floor of the excavation after the removal of unsuitable material</td>
<td>Prior to backfilling with replacement material</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Embankments - Foundations</td>
<td>Inspection of the embankment foundation area.</td>
<td>1 working day prior to next activity</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Embankments - Bridging layer</td>
<td>Inspection and direction for bridging layer where required</td>
<td>3 working days before proceeding</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Placing fill - Trimming tops of</td>
<td>Inspection of the completed surface to receive subsequent pavement layers</td>
<td>Prior to placing any subsequent pavement layers</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>embankments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selected material zone - Inspection</td>
<td>Inspection of the completed select material zone surface prior to placing any subsequent pavement layers</td>
<td>1 working day before proceeding</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Fill adjacent to structures - Treatment</td>
<td>Proposal to use synthetic membrane geotextile</td>
<td>3 working days before proposed use</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>at weepholes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Compaction and moisture requirements -</td>
<td>Present the completed work for deflection monitoring or proof rolling</td>
<td>2 working days before next activity</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Deflection monitoring or proof rolling</td>
<td></td>
<td></td>
<td></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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clause/subclause</td>
<td>Requirement</td>
<td>Notice for inspection</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td><strong>PRE-CONSTRUCTION PLANNING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural surface - Contractor’s</td>
<td>Survey method and results, including any discrepancies</td>
<td>At least 7 days notice</td>
</tr>
<tr>
<td>survey system</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Removal of topsoil - Program</td>
<td>Inspect cleared site prior to removal of topsoil</td>
<td>3 working days prior to removal</td>
</tr>
<tr>
<td>Cuttings - Floors of cuttings</td>
<td>Floors to be no more than 50 mm above or below the designed floor and provide suitable support</td>
<td>1 working day before next activity</td>
</tr>
<tr>
<td>Batters - Excavation beyond the</td>
<td>Minor change in the general slope of the batter to suit the site conditions</td>
<td>1 working day before next activity</td>
</tr>
<tr>
<td>batter line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transition from cut to fill -</td>
<td>Excavate a terrace for the width of the selected material zone to a depth of 900 mm below and parallel to the cutting floor.</td>
<td>1 working day before excavating terrace</td>
</tr>
<tr>
<td>Terrace</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsuitable material - General</td>
<td>Material deemed unsuitable for embankment or pavement support in its present position</td>
<td>Progressive</td>
</tr>
<tr>
<td>Embankments - Bridging layer</td>
<td>Supply and place bridging layer</td>
<td>1 working day prior to importing material</td>
</tr>
<tr>
<td>Placing fill - Rock pieces</td>
<td>Modify grading of fill material to achieve compaction</td>
<td>Progressive</td>
</tr>
<tr>
<td>Fill adjacent to structures -</td>
<td>Concrete strength required for early filling to structures</td>
<td>3 working days prior to fill placement</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spoil – Haulage disposal</td>
<td>Obtain planning approval and any permits</td>
<td>3 working days before commencing activity</td>
</tr>
<tr>
<td>Borrow - Requirement</td>
<td>Obtain planning approval and any permits</td>
<td>3 working days before commencing activity</td>
</tr>
</tbody>
</table>

2 PRE-CONSTRUCTION PLANNING

2.1 PROGRAMMING

Management
Resources: Provide planning resources to allocate plant and personnel for the contract period. Quality: Program the work to meet the constraints of **HOLD POINTS, WITNESS POINTS**.

2.2 NATURAL SURFACE

Contractor’s survey system
Approval: Submit details of the Contractor’s proposed survey system for approval within 14 days of possession of site being granted and prior to commencement of clearing and grubbing or earthworks.
Verification: The contractor may receive verified ground models prior to commencement of Contract. They will be in the form of computer generated road design data files in the format of the approved software.
Verification alternative: The Contractor may verify the accuracy of the model by field surveys. Discrepancies: If the Contractor considers any areas of the model not to be representative, or submitted plans to be inaccurate, give not less than 7 days notice, prior to commencement of Works to allow checking.
Survey: Submit survey verifying existing ground profile. This is a **WITNESS POINT**.
Costs: If the subsequent check survey reveals the ground model and plans to be correct, then the Contractor is to bear the cost of the check survey.
2.3 MANAGEMENT OF STOCKPILES AND BATTERS

Dust and sediment minimisation
Manage: Soil stockpiles so that dust and sediment in run-off are minimised as follows:
- Minimise the number of stockpiles, and the area and the time stockpiles are exposed.
- Keep topsoil and underburden stockpiles separate.
- Locate stockpiles away from drainage lines, at least 10 m away from natural waterways and where they will be least susceptible to wind erosion.
- Ensure that stockpiles and batters are designed with slopes no greater than 2:1 (horizontal/vertical).
- Stabilise stockpiles and batters that will remain bare for more than 28 days by covering with mulch or anchored fabrics or seeding with sterile grass.
- Establish sediment controls around unstabilised stockpiles and batters.
- Suppress dust on stockpiles and batters, as circumstances demand.

3 MATERIALS

3.1 MATERIAL CHARACTERISTICS

Assumptions
Quality and quantity: The Contractor is responsible for any assumptions made for the material or the quantity. This may include:
- Nature and types of the materials encountered in excavations.
- The bulking and compaction characteristics of materials incorporated in embankments.
- The estimated quantity for general earthworks at any cutting includes all types of materials which may be encountered in the cutting.

Embankment material deficiency
Embankment material: Use material from excavations if acceptable for embankments. Deficiency: If a deficiency of material for embankment construction is created by the Contractor electing to use the material for other purposes, make good that deficiency from sources of material meeting the quality requirements specified in Benching in cuttings.

3.2 CONTAMINATED MATERIAL AND WASTES

Excavating contaminated material
Contamination: Excavate and dispose of all contaminated material in an environmentally responsible manner including the following:
- Assay material uncovered on-site prior to disposal. If the wastes include putrescibles wastes, then also analyse leachate and landfill gases.
- Excavate material in a manner which avoids off-site environmental problems.
- Seal remaining contaminated material or wastes, where only part of the tip has been excavated, to ensure that there is no off-site effect now or in the future.
- Transport odorous wastes in covered vehicles.
- Dispose of contaminated material in a landfill licensed to take the type of contaminated material or wastes uncovered.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 ESTABLISHMENT

Excavation method
General: Provide a method statement covering excavation procedures based on geotechnical information shown on the drawings and/or geotechnical report.
Blasting: Provide details of special procedures for design and execution of blasting to meet all statutory and environmental requirements and in accordance with Annexure B.

**Protection of earthworks**

Erosion and sedimentation control: Install effective erosion and sedimentation control measures to 1102 Control of erosion and sedimentation prior to commencing earthworks and maintain these control measures for the duration of the contract.

Drainage of working areas: Maintain drainage of all working areas throughout the period of construction to ensure run-off of water without ponding, except where ponding forms part of an approved erosion and sedimentation control system.

Salinity prevention: In salt affected areas, take adequate precautions to minimise ingress of surface water into the groundwater table.

Wet weather precautions: If rain is likely or if work is not proposed to continue in a working area on the following day, take precautions to minimise ingress of any excess water into earthworks material.

Loose material: Seal off ripped material remaining in cuttings and material placed on embankments by compaction to provide a smooth tight surface.

Wet material: If in-situ or stockpiled material becomes excessively wet as a result of the Contractor not providing adequate protection of earthworks, replace and/or dry out the material to minimise any consequent delays to the operations. This is a HOLD POINT.

**Batter indicators**

Timing: Establish batter indicator boards and pegs before earthworks operations commence and after survey controls are in place.

Indicators: Locate indicators as follows:

- Horizontal: Generally 25 m intervals, at each cross section shown on the Drawings, or at each change in the slope of the batter, whichever is the lesser.
- Verified interval to not be more than 5 m height.

Information on the indicator: Clearly mark the chainage/station, offset from control line and slope distance to finished surface level.

Retention and removal of pegs: Maintain all pegs and batter indicators in their correct positions. Remove them on completion of the contract or separable part.

Additional pegs: Additional pegs and indicators may be required to suit the Contractor. Do not paint these with the same colours used for the specified setting out pegs and stakes.

Transitions cuttings/embankments: Mark with clearly labelled stakes in accordance with Transition from cut to fill and Foundations for embankments the position and extent of all transitions from cuttings to embankments and foundations for shallow embankments.

**Stockpile sites**

Additional stockpile sites: Obtain approval to use any stockpile site not shown on the Drawings. State the maximum dimensions of the proposed stockpile. This is a HOLD POINT.

Clearing and grubbing: To 1111 Clearing and grubbing.

Temporary erosion and sedimentation control measures: To 1102 Control of erosion and sedimentation.

Restoration: To 0257 Landscape – roadways and street trees following completion of the work.

### 4.3 REMOVAL OF TOPSOIL

**Program**

Timing: Commence removal of topsoil after erosion and sedimentation controls have been implemented and when clearing, grubbing and disposal of materials have been completed on that section of the Works to 1102 Control of erosion and sedimentation (Construction) and 1111 Clearing and grubbing.

This is a WITNESS POINT.

**Extent of work**

General: Remove topsoil throughout the length of the Work and stockpile separately clear of the work. Take care to avoid contamination by other materials.

Cuttings: Remove topsoil to a depth quoted in Annexure A or as directed.

Embankments: Remove topsoil over the base of embankments up to the depth below the natural surface quoted in Annexure A, or as directed.
Shallow embankments: If the height of embankment from natural surface to underside of pavement is less than 2 m, remove topsoil which is deeper than the depth quoted in Annexure A to its full depth as directed.

**Survey**

Earthwork volumes: Provide earthwork volumes if payment is on a ‘Schedule of Rates’ basis unless alternative arrangements have been made. After removing the topsoil, determine the surface levels in each cutting and embankment at sufficient locations to calculate the volume of excavation for general earthworks and the volume of compacted fill. This is a **HOLD POINT**.

**Stockpiles**

Height and batter: Conform to the following:

- Maximum height: 2.5 m.

Trim: To a simple shape.

**Erosion control**

Stabilisation: Track roll or stabilise by other approved means to minimise erosion.

Seeding: Where seeding of stockpiles is recommended, conform to 0257 Landscape – roadways and street trees.

### 4.4 CUTTINGS

**Cuttings in rock**

Dimensions: Provide detailed procedures to maintain accurate dimensions and uniform batters in rock.

**Acceptable material**

Cut: Construction of cuttings includes all operations associated with the excavation of material within the limits of the batters including benching, treatment of cutting floors and transition from cut to fill.

Preparation: Loosen and break down materials encountered in cuttings so that they are acceptable for incorporation in the Works.

Acceptable material: Refer to **Unsuitable material** and Embankment construction and **Embankment material**.

**Benching in cuttings**

Benches: Cut batters to be benched at locations and widths shown on the Drawings notwithstanding the tolerances permitted under **Batter tolerances**.

Bench maintenance: Remove loose stones and boulders regularly throughout the Contract period.

**Variable material**

Excavation methods: If material of variable quality or moisture content is encountered after topsoil has been removed, adjust excavation methods to ensure blending of the materials, to obtain material meeting the requirements of **Embankment material**.

**Floors of cuttings**

Excavation level: Excavate the floors of cuttings, parallel to the designed grade line, to a designed floor level at the underside of the selected material zone or where there is no selected material zone, to the underside of the pavement subbase.

Tolerance: Trim the floors to a level ± 50 mm to the designed floor level.

Unsuitable material: Remove as set out in **Unsuitable material**. This is a **WITNESS POINT**.

CBR testing: Prior to ripping the cutting floor, determine the CBR to AS 1289.6.1.1 of the material in the floor. Sufficient tests to be taken to represent all the various materials which may exist in the cutting floor. A direction will be given if material in the floors of cuttings has a CBR value less than the value quoted in Annexure A. This is a **HOLD POINT**.

**Ripping floors of cuttings**

Loosen: Rip material of the floor to a minimum depth of 200 mm below the designed floor level for the width of the selected material zone (or subbase layer, where no selected material zone). The maximum dimension of any particles in the ripped or loosened zone not to exceed 150 mm.

Inspection: Submit ripped or loosened material for inspection before re-compaction commences. This is a **HOLD POINT**.

**Compacting floors of cuttings**

Compaction: Re-compact ripped or loosened material to conform with **Compaction and moisture requirements**. No account to be taken of the volume involved in loosening when measuring the volume of excavations.

Trim: After re-compaction, re-trim the floors of cuttings parallel with the finished wearing surface.
Tolerances: Refer to Annexure A.
Inspection: Prior to placing subsequent layers over the completed cutting floor, present the completed surface for inspection. Verify as part of the quality system that the completed surface has achieved full conformance with all respects of this worksection. This is a HOLD POINT.

4.5 BATTERS

Batter slopes
Profile: Provide batter slopes as shown on the Drawings or directed on the basis of site inspection and investigation during the excavation.
Tops of cuttings: Neatly round tops of cutting to the dimensions shown on the Drawings.
Cutting batters: Batter for cuttings to be even and without undulations in the general plane of the batter except that batters may require progressive flattening at the ends of cuttings due to the presence of less stable material.
Unstable material: Clean cut faces of loose or unstable material progressively as the excavation proceeds.
Batter tolerances: The tolerances for the excavation of batters are given in Excavation tolerances for batters table.

<table>
<thead>
<tr>
<th>Location</th>
<th>Tolerance (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Slope 1:1 or flatter</td>
</tr>
<tr>
<td>Toe of batter and level of table drain</td>
<td>+ 0</td>
</tr>
<tr>
<td></td>
<td>- 150</td>
</tr>
<tr>
<td>2 m above table drain and higher</td>
<td>+ 300</td>
</tr>
<tr>
<td></td>
<td>- 300</td>
</tr>
<tr>
<td>Between level of table drain and 2 m above</td>
<td>pro rata basis</td>
</tr>
<tr>
<td>table drain</td>
<td></td>
</tr>
</tbody>
</table>

Note: Tolerances are measured normal to the batter surface with (+) measured towards the roadway.

Variation for batter slopes
Instruction: A variation to the Contract will be issued where batter slope of any section of a cutting after it has been completed to conform with this Clause is changed. The Contractor will require to reset out, remove additional material and retrim the batter. This is a HOLD POINT.
Costs: The costs of changing the batter slopes will be paid as a variation to the Contract.

Excavation beyond batter line
Corrective measures: Submit details of the material and/or methods proposed to restore the specified slope and stability of the batter. This is a WITNESS POINT.
Minor over excavation: Minor change in the general slope of the batter to suit the site conditions may be approved, however, this does not constitute a variation for batter slopes.
Batters steeper than 1:1: A direction to restore batter slopes may be given if any section of the batter up to a height of 3 m above the table drain level has been over excavated beyond the tolerance limit specified. The batter will be required to be restored to the average batter slope using randomly mortared stone.
Restoration material:
- Stone: Similar to the sound rock in the cutting and the
- Mortar: Coloured to match the colour of the rock.

4.6 TRANSITION FROM CUT TO FILL

Intersection line
Survey: Mark the position of the intersection line between cutting and embankment occurring at the underside of the selected material zone or pavement subbase, after the removal of topsoil and before the excavation of any cutting commences.

Terrace
Construction: Following excavation to the cutting floor, excavate a terrace for the width of the selected material zone (or subbase layer, where no selected material zone) to a depth of 900 mm below and parallel to the cutting floor, as shown in Figure Transition from cut to fill, unless otherwise approved. This is a WITNESS POINT.
Extent of terrace: Extend the cut to the point where the cutting floor is 900 mm below the original stripped surface, or a distance of 20 metres, whichever is the lesser.

Excavated material: Incorporate the material excavated in the embankments or dispose of as directed.

Quantities: Material incorporated in embankments to be included in the excavated volume for Pay item 1112.2 and spoil to be included in the excavated volume of Pay item 1112.3.

Quality and compaction: The material placed above the terrace to satisfy the requirements of Embankment material and be compacted to conform with Compaction and moisture requirements.

**Figure - Transition from cut to fill**

### 4.7 UNSUITABLE MATERIAL

#### General

Location: Unsuitable material is that occurring below the designed floor level of cuttings and below the nominated depth for stripping topsoil beneath embankments.

Unsuitable: If unsuitable material is identified for embankment or pavement support in its present position, remove and replace. This is a **WITNESS POINT**.

**Extent of excavation**

Removal: Excavate unsuitable material as directed

**Floor inspection**

Extent: After removal of the unsuitable material, and prior to backfilling with the replacement material, present the floor of the excavation for inspection. This will determine whether a sufficient depth of unsuitable material has been removed. This is a **HOLD POINT**.

Compaction: To conform with Compaction and moisture requirements, prior to replacing material.

**Replacement material**

Quality: Replace unsuitable material with material from cuttings, or with material borrowed in to conform with Borrow, of the quality specified in Embankment material.

Status: Replacement material is deemed to form part of embankment construction.

Construction: Place to conform with Placing fill for embankment construction and to conform with Compaction and moisture requirements.

Resultant unsuitable material: Rework or replace any material deemed to have become unsuitable because of inappropriate construction activities.

### 4.8 EMBANKMENTS

#### Embankment construction

Scope: Embankment construction includes:

- All operations associated with the preparation of the foundation areas on which fill material is to be placed, and the placing and compacting of approved material within areas from which unsuitable material has been removed.

- The placing and compacting of fill material and of materials of specified quality in nominated zones throughout the Works.

- All other activities required to produce embankments as specified to the alignment, grading and dimensions shown on the Drawings.

- Pre-treatment, such as breaking down or blending material or drying out material containing excess moisture.
Embankment material
Source and quality: Obtain the material for embankment construction from the cuttings within the Works to conform with **Benching in cuttings**, and supplement by borrow to conform with **Borrow** and from other sources as approved if necessary.
Quality: Free of tree stumps and roots, clay, topsoil, steel, organic material and other contaminants and suitable to be compacted to conform with **Compaction and moisture requirements**.
Availability: Program the work so that material of the quality specified in **Placing fill for embankment construction** and **Selected material zone** for the upper zones of the formation is available when required.

Foundations
Timing: Make the embankment foundation area available for inspection by the Superintendent following removal of topsoil This is a HOLD POINT.
Unsuitable material: If any underlying material is unsuitable remove and replace the material to conform with **Unsuitable material**.
Preparation: Grade and level the general area, adjust the moisture content where necessary and compact the top 200 mm as specified in **Compaction and moisture requirements**.

Foundations for shallow embankments
Type: Shallow embankments are those embankments of a depth less than 1.5 metres from the top of pavement to natural surface.
Quantity: Survey and calculate the extent of the area of shallow embankments after removal of topsoil.
Preparation: Loosen the material exposed to a depth of 200 mm, adjust the moisture content of the loosened material and compact as specified in **Compaction and moisture requirements**, after removing topsoil and unsuitable material.
Foundation damage: Use suitable equipment and techniques to minimise surface heaving or other foundation damage.

Bridging layer
Status: If a bridging layer has been specified as a foundation treatment in the Contract documents, supply and place it as part of **Pay item 1112.2**.
Material: The bridging layer to consist of free-draining granular material with or without geotextile interlayer as specified on the Drawings.
Method: End-dump the granular material and spread in a single layer in sufficient depth to allow the passage of earthmoving equipment with minimal surface heaving. The compaction requirements of **Compaction and moisture requirements** not to apply to the bridging layer.
Status: If it is necessary to import suitable material from off site and if no suitable borrow source is available as provided in **Natural surface and earthworks materials**, the supply and placing of the bridging layer may be treated as a Variation to the Contract. This is a WITNESS POINT.
Seepage from foundations: A bridging layer may also be employed, subject to approval, where ground water or seepage is encountered in the foundation area or where the Contractor demonstrates that it is impracticable to achieve the degree of compaction specified for the foundation in **Compaction and moisture requirements**. This is a HOLD POINT.
Unacceptable location: If its proximity to the pavement is likely to affect the pavement design.
Working platform: As an alternative to a bridging layer, approval of a working platform created by the chemical stabilisation of in situ material to conform with **1113 Stabilisation** may be required.

Hillside embankments
Criteria: If embankments are constructed on or against any natural slopes or the batters of existing embankments, and if the existing slope or batter is steeper than 4H:1V in any direction.
Terrace: Extent and method as follows:
- Cut horizontal terraces over the whole area to be covered by new filling.
- Step the existing slope or batter in successive terraces, each at least 1 metre in width, and cut the terraces progressively as the embankment is placed.
- Coincide terraces with natural discontinuities wherever possible.
- Provide subsoil drainage if required.
- Compact excavated material as part of the new embankment material.
Excavated volume: No account to be taken of the material removed in terracing when determining the excavated volume for **Pay item 1112.2**.
Batter slopes
Design criteria: The batter slopes shown on the Drawings represent the estimated requirements for the expected types of materials.
Redetermination: Batter slopes may be changed as directed following further assessment of the materials encountered on site.
Slope: When completed, the average planes of the batters of embankments are to conform to those shown on the Drawings or as directed.
Tolerance: Conform to the following:
- For a vertical distance to 1 m below the shoulder, no point on the completed batter to vary from the specified slope line by more than 150 mm when measured at right angles to the slope line.
- At distances greater than 1 m vertically below the shoulder, no point on the completed batter to vary from the specified slope line by more than 300 mm when measured at right angles to the slope.
- In no case is the edge of the formation at the underside of the pavement to be nearer to the roadway than shown on the Drawings and the batter slope at no point be steeper than the specified slope.
Slope undulations: Avoid and remove undulations in the general plane of the batter.
Slope redetermination: A direction to change the slope of any section of an embankment batter that has been completed to conform with this Clause, will constitute a Variation to the contract. The Contractor will require to reset out and remove or add fill material and retrim the batter.

Batter slope for median areas
Requirement: The batter slopes for median areas to conform to those shown on the Drawings and undulations in the general plane of the batter slope are not permitted.
Batter tolerances:
- For a horizontal distance of 2 m from the edge of the shoulder, no point on the completed batter to vary from the specified slope line by more than 50 mm when measured at right angles to the slope line within 24 hours after compaction.
- At distances greater than 2 m horizontally from the edge of the shoulder, no point on the completed batter to vary from the specified slope line by more than 100 mm when measured at right angles to the slope line within 24 hours after compaction.
Free draining: The medians to be graded so as not to pond water.

Rock facing of embankments
Type: Embankment batters, including embankments at bridge abutments, to be faced with clean, hard, durable rock.
Location: Where shown on the Drawings.
Rock placement: Exercise extreme caution whilst placing the rock facing as follows:
- Where embankment material is placed above other roads in use, place the outer rock layer in such a manner as to prevent movement down the batter or onto the roadway.
- Ensure that, under no circumstances, any rock can be dislodged and roll onto any adjacent roadway or track in use.
- Provide traffic control procedures to ensure safe passage of vehicles and pedestrians.
Mechanical interlock: Build up the rock facing in layers ahead of each layer of filling. Place rock by hand or plant in such a manner that its least dimension is vertical and that mechanical interlock between the larger stones occurs.
Excess fine material: Remove rock facing that has an excess of fine material surrounding it, together with the fine material, and replace rocks.
Rock supply: Adjust working methods and program the work so as to obtain hard and durable rock of the specified dimensions as it is required.
Graded filter: Fill the space between larger batter rocks with progressively smaller rocks to form a ‘graded filter’ which prevents the leaching out of fines from the fill material but which does not overfill the voids between larger rocks, or cause the larger rocks to lose contact with one another. Remove fine material from the outside of the rocks on the face of the batter.
Leaching: Use an appropriate geotextile for embankment construction to prevent the leaching out of fines from the fill material as shown on the drawings.
4.9 PLACING FILL

General
Uniformity of material: Select the methods of excavation, transport, depositing and spreading of the fill material so as to ensure that the placed material is uniformly mixed.
Embankment stability: Construct the embankment and stabilise by compaction of the fine material embedding the rock pieces. Compact fine material to meet the requirements of Compaction and moisture requirements.
Sources of material and processing: Determine suitable sources of material and any processing to satisfy these quality requirements.

Layer thickness
Placement: Place layers parallel to the grade line and compact to conform with Compaction and moisture requirements.
Description: Uniform compacted layers of thickness not exceeding 200 mm
Large rock: Approval required to increase thickness where more than 25% by volume of the filling consists of rock with any dimension larger than 150 mm.
Direction: Approval required to increase in the compacted layer thickness to 300 mm, provided that the relative compaction specified in Compaction and moisture requirements is attained.

Rock pieces
Maximum size: Less than two-thirds of the approved compacted layer thickness measured in any direction. Reduce any larger rock pieces in size for incorporation in the embankment layers.
Grading of fill material: Break down rock material and evenly distribute it through the fill material, and place sufficient fine material around the larger material as it is deposited to achieve the specified compaction of each layer and produce a dense, compact embankment.
Insufficient fine material: If deemed insufficient fine material is present to fill the voids, obtain additional fine material from other places in the work or change the method of winning fill material. This is a WITNESS POINT.

Stony patches
Insufficient fine material: Rework stony patches having insufficient fine material to achieve compaction, with additional fine material blended in to achieve a dense, compact layer.
Equipment selection for placement: In placing embankment layers, use suitable equipment and techniques to avoid surface heaving or other damage to the foundations and underlying embankment layers.

CBR value
Value: Compacted embankment material in the selected material zone and below (or subbase layer, where no selected material zone) to have a CBR value not less than that quoted for the depth(s) specified in Annexure A.
Test method: The CBR value of the material to be determined by Test Method AS 1289.6.1.1

Trimming tops of embankments
Embankment: Trim the top of embankments parallel to the designed grade line at levels equal to the finished surface level less the thicknesses of pavement courses and the selected material zone if applicable.
Compaction: Compact the tops of embankments at these levels to meet the requirements of Compaction and moisture requirements.
Tolerances: Trim to maximum 10 mm above or 40 mm below the levels as calculated above.
Inspection: Present the completed surface for inspection before placing any subsequent pavement layers over the completed top of embankment filling. Verify as part of the quality system that the completed surface has achieved full conformance with all respects of this worksection. This is a HOLD POINT.

4.10 SELECTED MATERIAL ZONE

Site won selected material
Quality: Conform to the following:
- Free from stones larger than 100 mm maximum dimension and have no less than 50% passing the 19 mm sieve.
- Have a CBR value not less than that specified in Annexure A for the fraction passing 19 mm AS sieve.
- Plasticity Index of 15 maximum.
Stabilisation: If chemical stabilisation is specified these requirements must apply to the selected material immediately prior to incorporating the stabilising agent.

Winning material: Obtain the selected material from cuttings excavated under the Contract or from borrow areas as specified in Borrow.

Working methods: Use working methods to yield material that conforms to the requirements of this Clause, and break down oversize rock if required.

**Conservation of material**

Stockpiles: If the material is not placed directly in the selected material zone, stockpile it at approved locations for future use until at least sufficient material is reserved to complete the selected material zone over the whole work.

Extra material: If suitable available material has not been conserved, provide material of equivalent quality.

**Placing and compaction**

Layers: Place and compact in layers with the compacted thickness of each layer not exceeding 150 mm, homogeneous and free from patches containing segregated stone or excess fines. Refer to **Compaction and moisture requirements**.

Non-complying material: Exclude all non-complying material from all areas.

Top of the selected material zone: Compact and trim parallel with the designed grade line at a level equal to the finished surface level minus the thickness of pavement layers adopted. The tolerances for the trimmed levels are given in Annexure A.

**Inspection**

Timing: Present the completed surface for inspection prior to placing any subsequent pavement layers over the completed select material zone surface.

Conformance: Verify as part of the quality system that the completed surface has achieved full conformance with all respects of this worksection. This action is a **HOLD POINT**.

### 4.11 FILL ADJACENT TO STRUCTURES

**General**

Payment: Supply and placement of fill adjacent to structures is deemed to be part of Pay item 1112.2.

Structure types: Structures include bridges, precast and cast-in-place box culverts and retaining walls.

Cross references: Fill adjacent to other culverts and drainage structures to be provided to conform with 1351 Stormwater drainage (Construction), 1352 Pipe drainage, 1353 Precast box culverts and 1354 Drainage structures.

Time of placement: Do not place fill against structures, retaining walls, headwalls or wing walls within 21 days after placing of the concrete.

Approval required: To decrease the lag time the walls may be supported by struts, or the Contractor can demonstrate that 85% of the design strength of the concrete has been achieved. This includes concrete in bridge decks and fill placement that impacts the position, stability and serviceability of bridge deck member bearings. This is a **WITNESS POINT**.

**Treatment at weepholes**

Gravel: Provide drainage adjacent to weepholes by a layer of broken stone or river gravel consisting of clean, hard, durable particles graded from 50 mm to 10 mm as follows:

- The maximum particle dimension not to exceed 50 mm,
- No more than 5% by mass to pass the 9.5 mm AS sieve.

Extent: Continuous in the line of the weepholes, extend at least 300 mm horizontally into the fill and extend from 200 below to at least 450 mm vertically above the level of the weepholes, where practicable.

Geotextile membrane: Alternatively, provide a geotextile membrane of equivalent drainage characteristics at no extra cost. Store and install in accordance with Manufacturer’s instructions. The use of geotextile is subject to approval. This is a **HOLD POINT**.

**Selected backfill**

Location: Place selected backfill adjacent to structures to conform with **Selected backfill width and height table**.

Material: Selected backfill to consist of a granular material having a maximum dimension not exceeding 50 mm and a Plasticity Index, determined by AS 1289.3.3.1, neither less than 2 nor more than 12.
Selected backfill width and height table

<table>
<thead>
<tr>
<th>Structure type</th>
<th>Selected backfill width</th>
<th>Selected backfill height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridge abutments</td>
<td>2 m</td>
<td>H</td>
</tr>
<tr>
<td>Cast-in-place box culverts</td>
<td>H/3</td>
<td>H + 300 mm</td>
</tr>
<tr>
<td>Corrugated steel pipes and arches</td>
<td>0.5 m</td>
<td>H + 500 mm</td>
</tr>
<tr>
<td>Retaining walls</td>
<td>H/3</td>
<td>H</td>
</tr>
</tbody>
</table>

Where H = height of structure)

Placement: Place the selected backfill in layers, with a maximum compacted thickness of 150 mm simultaneously on both sides of box culverts and other drainage structures to avoid differential loading. Start compaction at the wall and proceed away from it, meeting the requirements of Compaction and moisture requirements.

Horizontal terraces: Cut the existing embankment slope behind the structure in the form of successive horizontal terraces, each terrace being at least 1 m in width, and the selected backfill placed to conform with Placing fill for embankment construction.

Spill through abutments: Do not dump rocks against the columns or retaining walls, build up evenly by individual placement around or against such structures.

Framed structures: For embankments at both ends of the structure, bring up backfill at both ends simultaneously, keeping the difference between the levels of the embankments less than 500 mm.

4.12 SPOIL

General
Spoil: The surplus material from excavations under the Contract that is not required to complete the Works as specified or material from excavations under the Contract whose quality is deemed to be unacceptable for incorporation in the Works.

Incorporation in the works
Embankments: The Superintendent may direct flatter batter slopes or uniform widening on embankments that have not been commenced. The surface shaped to provide a tidy appearance and effective drainage.

Surplus material: Spread and compact the surplus material as specified in Placing fill for embankment construction and Compaction and moisture requirements for material in embankments.

Haulage disposal
Planning approval: Obtain planning approval and bear all costs in obtaining such approval by Council’s Town Planning Manager, if handling of spoil is involved. This is a WITNESS POINT.
Method: Dispose of spoil in a manner and at approved locations. Compact spoil as specified in Compaction and moisture requirements for material in embankments.

Payment
Haulage: Disposal of spoil as follows:
- Up to five kilometres from the point of excavation to be included in Pay item 1112.2.
- If haulage exceeds five kilometres, payment to be made at the rate nominated in Annexure A for haulage of spoil.

4.13 BORROW

Requirement
Criteria: Unless provided by the Contract, borrow will only be authorised for:
- Constructing cuttings and embankments to the batter slopes as directed.
- Providing materials of the quality specified.
- When there is an overall deficiency in either the quantity or the quality of material required to complete the works.
Wastage: Borrow will not be authorised for excess widening of embankments or wastage of quality material by the Contractor.
Material quality: As approved and to conform with Embankment material, Rock facing of embankments, or Fill adjacent to structures.
Permits: Obtain approval by Council’s Town Planning Manager and any permits required for entry on land and pay any royalty for such borrow material. This is a WITNESS POINT.

Authorities: Comply with any requirements of the Local Council, land owners, and the State and Territory environmental planning legislation, livestock protection boards and soil conservation services, as appropriate.

**Borrow sites**

Location: Ensure the edges are no closer than 3 m from any fence line, road reserve boundary or edge of excavation or embankment and provide adequate clearance for the construction of catch drains.

Borrow site location: As approved by the Superintendent.

Drainage: Provide drainage outlets acceptable to the Superintendent.

Batter slopes:
- Not steeper than 4 H: 1 V.
- To be left in a tidy and safe condition.

Site preparation and restoration: For borrow within the defined working area for the Works as specified, site preparation to be in accordance with 1111 Clearing and grubbing and Removal of topsoil.

Restoration: Restore borrow sites to 0257 Landscape – roadways and street trees.

Widening of cutting: If borrow material is obtained by uniformly widening a cutting, apply the requirements of Excavation, Batter tolerances and Treatment of floors of cuttings to the redetermination of batter slopes, the trimming of batters and the compaction of floors of cuttings respectively.

**Payment**

Borrow: Payment to be made to the Contractor as follows:
- Within the specified working area is deemed to be part of Pay item 1112.2.
- If the Superintendent accepts that borrow must to be obtained from locations outside the specified working area for the Works, such work to be treated as a Variation to the Contract.

Haulage: If haulage exceeds five kilometres, payment to be made at the rate nominated in Annexure A for haulage of borrow.

### 4.14 COMPACTION AND MOISTURE REQUIREMENTS

**Trimming and compaction**

Sequence: Compact all layers uniformly to not less than the relative compaction specified before the next layer is commenced.

Trimming: Trim each layer of material prior to and during compaction to avoid bridging over low areas and to present a smooth surface at the top of each layer.

**95% Compaction**

Requirements: Compact the following areas to provide a relative compaction, not less than 95% determined by AS 1289.5.7.1 or AS 1289.5.4.1 for standard compactive effort to the following:
- Each layer of material replacing unsuitable material as detailed in Unsuitable material.
- Each layer of material placed in embankments, up to 1.5 metres from the top of the pavement.
- Fill placed adjacent to structures up to 1.5 metres from the top of pavement.
- Material in unsealed verges and within medians up to the level at which topsoil is placed.
- Spoil (excluding unsuitable material).
- All other areas except those where higher relative compaction is specified.

Unsuitable material: Stockpile unsuitable material as directed by the Superintendent and compact by track rolling.

**100% Compaction**

Requirements: Compact the following areas to provide a relative compaction of not less than 100% as determined by AS 1289.5.7.1 or AS 1289.5.4.1 for standard compactive effort to the following:
- Foundations for shallow embankments.
- The whole area on the floor of cuttings.
- Each upper zone layer of the embankment within 1.5 metres from the top of pavement.
- Each layer of the selected material zone as specified in Selected material zone.
- Any areas of material of specified quality which may be shown on the Drawings or specified elsewhere behind kerbs and/or gutters or adjacent to rigid pavements.

- The fill material placed adjacent to structures as specified in Fill adjacent to structures and Selected backfill in each layer within 1.5 metres from the top of the pavement.

**Shallow cutting**

Definition: Cut the prepared subgrade to a depth below natural surface of less than 0.5 metres where the vertical alignment design is such that a substantial portion of the road is required to be built at or close to the natural surface.

Treatment: Treat the floor of shallow cutting as specified in Treatment of floors of cuttings and Transition from cut to fill and compact to provide a relative compaction of not less than 97% for a depth of 200 mm determined by AS 1289.5.7.1 or AS 1289.5.4.1, for modified compactive effort.

**Cut-fill transition**

Requirement: Approval is required when shallow cutting conditions occur, the specified transition from cut to fill may be modified such that the depth of terrace excavation at the transition from cut to fill is reduced from 900 mm to 250 mm.

**Proof rolling**

Requirement: Proof roll as directed in Annexure A sections where ripping or loosening of the cutting floor is not required.

Locations: Proof rolling to conform with Deflection monitoring or proof rolling.

**Moisture content**

Compaction timing: Adjust the moisture content of the material at the time of compaction to permit the specified compaction to be attained at a moisture content which is within the range set out in Annexure A of the optimum moisture content as determined by AS 1289.5.1.1 or AS 1289.5.7.1.

- Wet material: Do not compact material that has become wetted up after placement until it has dried out so that the moisture content is within this range.

- Aeration: The drying process may be assisted by aeration, or where approved, by the use of hydrated or quick lime at the Contractor’s cost.

- Drying: Alternatively the Contractor may transport the wet material to a stockpile site for drying out and later use as fill material at the Contractor’s cost.

- Dry material: If the material is too dry for compaction as specified, add water. Apply water uniformly and thoroughly mix with the material until a homogeneous mixture is obtained.

**Compaction**

Extent: Undertake compaction to obtain the specified relative compaction for the full depth of each layer in embankments and for the full width of the formation over the entire length of the work.

Rain damage: Complete compaction promptly to minimise the possibility of rain damage.

Repair: Loosen, recondition and recompact rain damaged surfaces before placing another layer of material.

**Compaction and moisture tests**

Test locations: Determine sampling locations for testing as described in 0161 Quality – Construction.

Preparation: Prepare the area at the determined locations for specified compaction and moisture tests.

Moisture content: Prior to testing, work the lot to ensure uniform moisture content and compaction of all material within the lot.

Test representation: The test/s then taken are to be considered to represent the total volume of material placed within the lot.

Further testing: If the material which is present has not achieved uniformity required by this Clause or Placing fill for embankment construction, further testing may be directed. The Superintendent to nominate the area to be represented by the additional testing.

Material not conforming: If such testing confirms that material not conforming to the worksection is present, perform remedial work as necessary to achieve conformance to the requirements of Compaction and moisture requirements.

**Deflection monitoring or proof rolling**

Presentation for testing: Present the work available in lots, for the Superintendent to carry out deflection monitoring or proof rolling. Further compact as directed due to results of proof rolling. This is a HOLD POINT.

Timing: Following completion of the formation to the underside of the selected material zone and completion of the selected material zone.
Size: A continuous length of formation of at least 300 m, or lesser length as approved, and a single carriageway width which is generally homogeneous with respect to material and appearance.

Boundaries: Identify the boundaries of each lot with stakes clearly labelled to the satisfaction of the Superintendent.

Costs: The cost of preparing the surface for deflection monitoring or proof rolling is included in the rate for Pay item 1112.2.

4.15 FURNITURE AND SERVICES

Widening of formation

General: Widen road shoulders and formation to accommodate footpaths, guard fence, streetlight plinths, emergency telephone bays and vehicle standing areas as shown on the Drawings.

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>Location or timing</th>
<th>Limits/Tolerances</th>
<th>Worksection clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batter slopes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation</td>
<td>At toe of batter and level of table drain</td>
<td>Batter (\leq 1:1), + 0, - 150 mm Batter (&gt; 1:1), + 0, - 200 mm</td>
<td>Batters/Excavation tolerances for batters</td>
</tr>
<tr>
<td></td>
<td>2 m above table drain and higher</td>
<td>Batter (\leq 1:1), ± 300 mm Batter (&gt; 1:1), ± 600 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Between level of table drain and 2 m above table drain</td>
<td>Pro-rata basis</td>
<td></td>
</tr>
<tr>
<td>Embankment</td>
<td>1 m below shoulder</td>
<td>± 150 mm</td>
<td>Embankments/ Batters slopes</td>
</tr>
<tr>
<td></td>
<td>More than 1 m below shoulder</td>
<td>± 300 mm</td>
<td>Embankments/ Batters slopes</td>
</tr>
<tr>
<td>Median Areas</td>
<td>2 m from edge of shoulder</td>
<td>± 50 mm</td>
<td>Embankments/ Batters slopes for median areas</td>
</tr>
<tr>
<td></td>
<td>More than 2 m from edge of shoulder</td>
<td>± 100 mm</td>
<td></td>
</tr>
<tr>
<td>Embankments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimming tops of embankments</td>
<td>At completion of embankment construction</td>
<td>Parallel to the designed grade line, + 10 mm or - 40 mm of the levels specified</td>
<td>Placing fill/Trimming tops of embankments</td>
</tr>
<tr>
<td>Selected material</td>
<td>Rock Quality</td>
<td>Minimum CBR value as per Annexure A</td>
<td>Selected material zone/Site won selected material</td>
</tr>
<tr>
<td>Selected backfill</td>
<td>Adjacent to structures</td>
<td>Plasticity Index 2 to 12</td>
<td>Fill adjacent to structures/ Selected backfill</td>
</tr>
</tbody>
</table>

Plus (+) is towards the roadway/surface and minus (−) is away from the roadway/surface. Tolerances are measured at right angles to the slope line.
6 MEASUREMENT AND PAYMENT

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 1112.1 to 1112.6 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:

- Control measures for erosion and sedimentation are measured and paid in accordance with 1102 Control of erosion and sedimentation.
- Clearing and grubbing of stockpile sites and borrow areas is measured and paid in accordance with 1111 Clearing and grubbing.
- Seeding and restoration of stockpile sites and borrow areas is measured and paid in accordance with 0257 Landscape – roadways and street trees.
- Traffic control for blasting operations is measured and paid in accordance with 1101 Control of traffic.
- Fill adjacent to culverts, other than box culverts, and drainage structures is measured and paid in accordance with 1351 Stormwater drainage (Construction), 1352 Pipe drainage.
- Selected backfilling to box culverts is measured and paid in accordance with 1353 Precast box culverts.
- Working platforms created by chemical stabilisation are measured and paid in accordance with 1113 Stabilisation.

6.2 PAY ITEMS

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
</table>
| 1112.1 Removal and stockpiling of topsoil     | m³ excavated        | The volume to be the sum of: 
- The volume removed from cuttings calculated by multiplying the area of cutting to be stripped as calculated from the plans of natural surface or accepted Ground Model by the depth of topsoil directed to be removed by the Superintendent, plus;
- The volume removed from under embankments calculated by multiplying the area to be stripped as calculated from the plans of natural surface or accepted Ground Model by the depth of topsoil stripping as nominated in Annexure A, plus;
- The additional volume of topsoil removed from shallow embankments below the depth nominated in Annexure A and calculated on the basis of plan area multiplied by the directed depth of excavation, or as directed. |
| 1112.2 General earthworks                     | m³ measured as volume. | The volume of earthworks in cuttings to be determined by the surface to surface triangulation method, All costs associated with all activities associated with stripping topsoil, carting and placing into stockpile, then stabilising and trimming the stockpiles. |

The schedule rate for this Pay Item to be an average rate to cover all types of material encountered during excavation and placed in
<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1112 Earthworks (Roadways)</td>
<td>calculating the volume between the plans of natural surface or accepted Ground Model, the designed batter lines and the base of the excavation; from which is deducted the volume of topsoil as calculated under <strong>Pay item 1112.1</strong>. No account to be taken of the allowable batter tolerances or stepping of batters for topsoiling.</td>
<td>embankments or spoil stockpiles, including both earth and rock. All costs associated with all documentation, approvals, survey and all activities associated with the excavation of material and the construction of embankments, stockpiling of spoil, the haulage of material and any pretreatment such as breaking down or blending material or drying out material containing excess moisture, except that: - removal of unsuitable material to spoil to be paid under <strong>Pay item 1112.3</strong>; - extra costs in processing selected material to be paid under <strong>Pay item 1112.4</strong>; - overhaul of spoil or borrow to be paid under <strong>Pay items 1112.5 and 1112.6</strong> respectively. The base of the excavation to be the designed floor level in accordance with <strong>Treatment of floors of cuttings</strong> and no account to be taken of level tolerances. Where unsuitable material from the foundations of shallow cuttings or material from cut to fill transitions is excavated and placed into embankments the volume to be calculated from joint surveys carried out immediately prior to, and after subsequent removal of the unsuitable material, or by other methods which may be approved by the Superintendent.</td>
</tr>
</tbody>
</table>

**1112.3 Unsuitable material to spoil**

m³ measured as volume of excavation

This **Pay item** refers only to unsuitable material as defined in **Unsuitable material** which is removed to spoil stockpile. If the material is such that the volume of excavation cannot be measured, the Superintendent will determine the conversion factors to be applied to the loose volumes measured in haulage units or to the measured stockpile volumes. All costs associated with all operations involved in the excavation, haulage, drying out, compaction or other activity required under **Unsuitable material** for its disposal as spoil in accordance with **Spoil**. When this **Pay item** provides for ranges of provisional quantities, the
rates are to be applied successively, but not cumulatively, as the volume of unsuitable material increases from one provisional quantity range to the next higher range. Each rate to be applied as the sole payment due for all unsuitable material removed within each quantity range, irrespective of the nature or quantity of the material removed.

Pay item 1112.4 Selected material

<table>
<thead>
<tr>
<th>Pay item</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1112.4 Selected material</td>
<td>m³ measured as embankment volume in place in the selected material zone. The volume to be determined by multiplying the theoretical plan area of the top of the selected material zone with its nominated thickness.</td>
<td>All costs associated with extra costs involved in stockpiling, processing, placing, compaction and trimming of material, including surface preparation for deflection monitoring in the selected material zone over and above those costs allowed for under Pay item 1112.2. The width and depth to be taken as shown on the Drawings or as directed by the Superintendent. No account is to be taken of level tolerances.</td>
</tr>
</tbody>
</table>

Pay item 1112.5 Haulage of spoil

<table>
<thead>
<tr>
<th>Pay item</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1112.5 Haulage of spoil</td>
<td>Per bank m³ for each kilometre or part thereof in excess of five kilometres.</td>
<td>Where an approved location for spoil disposal is more than five kilometres by road from the point of excavation of material being spoiled, payment to be made for haulage at the rate nominated in Annexure A and include all costs associated with this activity.</td>
</tr>
</tbody>
</table>

Pay item 1112.6 Haulage of borrow

<table>
<thead>
<tr>
<th>Pay item</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1112.6 Haulage of borrow</td>
<td>Per bank m³ for each kilometre or part thereof in excess of five kilometres.</td>
<td>Where an authorised borrow site that was not nominated in the Contract, is more than five kilometres by road from the point of delivery of borrow material to the Works, payment to be made for haulage at the rate nominated in Annexure A and include all costs associated with this activity.</td>
</tr>
</tbody>
</table>
# 7 ANNEXURE A

## 7.1 EARTHWORKS INFORMATION

<table>
<thead>
<tr>
<th>Worksection clause/ subclause</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removal of topsoil/ Extent of work</td>
<td>The depth below natural surface up to which the removal and measurement of top soil shall apply:</td>
<td></td>
</tr>
<tr>
<td>- Cutting areas</td>
<td></td>
<td>mm</td>
</tr>
<tr>
<td>- Embankment areas</td>
<td></td>
<td>mm</td>
</tr>
<tr>
<td>Cuttings /Floors of cuttings</td>
<td>Minimum CBR value in cutting floors used for design of pavement</td>
<td>%</td>
</tr>
<tr>
<td>Cuttings/ Compacting floors of cuttings</td>
<td>Construction tolerances, of the designated grade and crossfall, for floors of cuttings after recompackation</td>
<td>mm</td>
</tr>
</tbody>
</table>

### Embankments /Foundations for embankments

Requirements of material in foundations for shallow embankments:
- Moisture Content within the range of ___ % to ___ % of optimum.

### Selected material/Site won selected material

Upper Zones of Formation & Selected Material Zone

Material within each zone to have a CBR value of not less than that given in the table below under the nominated test conditions.

<table>
<thead>
<tr>
<th>Location</th>
<th>Minimum CBR Value</th>
<th>Depth</th>
<th>Nominated Soaking Period (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Selected Material Zone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Material below Selected Material Zone to 1.5 m from top of pavement.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Selected material zone/ Placing and compaction

Construction tolerances for Selected Material Zone are:
- designed grade and cross fall

+ mm

+ mm

### Spoil/ Payment

Haulage of spoil under Pay item 1112.5 to be payable at the rate of $___ per bank cubic metre per kilometre in excess of 5 km.

### Borrow/ Payment

Haulage of borrow under Pay item 1112.6 to be payable at the rate of $___ per bank cubic metre per kilometre in excess of 5 km.

### Compaction and moisture requirements/ Proof rolling

- Sections of work nominated to be in shallow cutting: ...........................................
- Ripping or loosening [is / is not] required in shallow cutting.
- Proof rolling of subgrade [is / is not] required.

### Compaction and moisture requirements/ Moisture content

- Material in upper zones of formation within the range of ___ % to ___ % of optimum
- All other embankment material within the range of ___ % to ___ % of optimum
8 ANNEXURE B - BLASTING

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>General</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-blast survey</td>
<td>Determine and record the existing condition of all structures</td>
<td>7 days before the start of blasting operations</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Survey report</td>
<td>Advise Superintendent of blasting charge details and adequacy of survey</td>
<td>3 days before the start of blasting</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Proposed blasting procedure</td>
<td>Written details of the proposed blasting procedure including proposed measures to limit noise and damage</td>
<td>Before the start of blasting operations - progressive</td>
<td>Superintendent</td>
</tr>
<tr>
<td>Control of air blast over-pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excessive air blast over-pressure</td>
<td>Suspend further blasting work and submit proposals of additional steps and precautions to avoid recurrence</td>
<td>24 hours prior to next activity</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>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Licences</td>
<td>Obtain all necessary licences and comply with all Government and Council regulations.</td>
<td>7 days before initiating blasting</td>
</tr>
<tr>
<td>Blasting records</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recording procedure</td>
<td>Prepare records as holes are loaded and signed by the Powderman</td>
<td>On the day of the blast</td>
</tr>
<tr>
<td>Advice to residents</td>
<td>Report any special condition affecting any resident</td>
<td>Progressive – 24 hours prior to blasting</td>
</tr>
<tr>
<td>Control of ground vibration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring vibrations</td>
<td>Design may be adjusted provided that further ground vibration monitoring is done and it is demonstrated that peak particle velocity limits are not exceeded</td>
<td>24 hours before next activity</td>
</tr>
</tbody>
</table>

8.1 GENERAL

Licences

Requirement: When explosives are permitted to be used by the Superintendent, and the Contractor wishes to undertake blasting, obtain all necessary licences from the appropriate authorities, and comply with all Government and Council regulations relating to transport, storage, handling and the use of explosives and also to the rules set out in AS 2187.1 and AS 2187.2. Conform to the following:

- The transport of explosives to be in accordance with the Australian Code for the Transport of Explosives by Road and Rail. This is a WITNESS POINT.
- Comply with the requirements of the Environment Protection Authority (EPA).
- The Contractor to be liable for any accident, damage or injury to any person, property or thing, resulting from the use of explosives.

Pre-blast survey
Requirement: Before the start of blasting operations, conduct a survey in the presence of the Superintendent to determine and record the existing condition of all structures likely to be affected by any blast. This is a HOLD POINT.
Extent of survey: The survey to include all structures (including utility services) within 500 m of any blast and extended where the Maximum Instantaneous Charge proposed is likely to produce peak particle velocities greater than allowable at structures more remote from a blast site.

Survey report
Content: Submit a written report of the survey, supported by photographs where necessary, together with a list of any existing defects in the structures, to the owner of each structure and to the Superintendent before blasting commences.

Maximum instantaneous charge: Submit for approval the Maximum Instantaneous Charge and the Contractor’s validation of the adequacy of the proposed structural survey at least three working days before the survey is due to commence. This is a HOLD POINT.

Blast monitoring: Amend survey where required due to the outcome of blast monitoring.

Proposed blasting procedure
Written submission: Before each blasting operation, submit written details of the proposed blasting procedure including:
- The quantity and type of explosive to be detonated
- The blasting pattern to be used
- Measures proposed to limit noise
- To ensure that vibration from blasting does not adversely affect nearby structures.

This action is a HOLD POINT.

Release of the HOLD POINT does not in any way reduce the Contractor’s responsibility set out in Contractor to obtain licences.

Limits on vibration: To BS 6472-1.
Ground vibration: Ground vibration caused by blasting not to exceed the values of peak particle velocity listed in the Limiting peak particle velocity table.

<table>
<thead>
<tr>
<th>Limiting peak particle velocity table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Point of Potential Damage (within 1 km of blasting site)</td>
</tr>
<tr>
<td>Completed and cured bridge structures or sub-structures (e.g. completed abutment)</td>
</tr>
<tr>
<td>Bridgeworks and structural retaining walls under construction</td>
</tr>
<tr>
<td>Residential premises, schools, hospitals and other buildings</td>
</tr>
<tr>
<td>Buildings or monuments of historical significance</td>
</tr>
</tbody>
</table>

Advice to residents
Procedure: Advise all residents within a radius of 1 km, by letter drop before blasting operations commence. Details to include the likely times, frequency and duration of blasting and precautions being taken to ensure that damage to property will not result. Ensure residents acknowledge receipt of this advice. Report any special condition or approval requirement affecting any resident to the Superintendent. This is a WITNESS POINT.
Time limits: Unless otherwise approved, blasting operations to be confined to the periods Mondays to Fridays (excluding public holidays), 9 am to 3 pm.
Safety precautions: When blasting operations are being carried out, take precautions to ensure the safety of persons and animals and the road to be closed to traffic and the appropriate signs erected in accordance with 1101 Control of traffic.
Warning procedure: Establish and observe a standard warning procedure at all times to AS 2187.2.
Presplitting
Where presplitting is carried out the spacing of presplit drill holes not to exceed 750 mm centre to centre.

8.2 BLASTING RECORDS
Records to be kept
Requirement: Maintain accurate records of each blast showing the details listed below:
- Date and time of blast.
- Location, number and diameter of holes loaded.
- Depth of each hole loaded.
- Inclination of holes.
- Maximum and minimum burden.
- Types of explosives used.
- Charge distribution in each hole.
- Maximum Instantaneous Charge.
- Delay periods and sequence.
- Total amount of charges in the blast.
- Length and type of stemming in each hole.

Recording procedure
Methodology: Prepare the records as holes are loaded and signed by the Powderman. Provide a copy to the Superintendent on the day of the blast. This is a WITNESS POINT.

8.3 CONTROL OF AIR BLAST OVER-PRESSURE
Proximity to noise sensitive locations
Application: This Clause only applies where a noise sensitive location exists within 1 km of the blasting site.
Noise control manual: The Contractor’s attention is drawn to the recommendations given in the EPA Environmental criteria for road traffic noise for the reduction of air blast over-pressure.
Noise limitations: Limit the noise emanating from blasting operations to an over-pressure level of 115 decibels (linear peak) at any noise sensitive location (such as residential premises, schools or hospitals). Up to 10% of the total number of blasts may exceed this value provided a level of 120 decibels is not exceeded at any time.

Monitoring of air blast over-pressure
Procedure: Conform to the following:
- Arrange for the monitoring of air blast over-pressure to ensure compliance with the specified limits.
- All monitoring to be carried out by personnel possessing current NATA registration.
- Report all test results on NATA endorsed test certificates which include a clear statement as to compliance or non-compliance with the requirements of this worksection.
- In general, establish a monitoring location near the perimeter of the noise sensitive location at the point closest to the maximum charge.
- Submit a copy of the monitoring record to the Superintendent.

Excessive air blast over-pressure
Procedure: In the event that the measured air blast over-pressure exceeds the specified limits, suspend further blasting work and submit proposals detailing any additional steps and precautions that will be taken to ensure that for any future blast, the limiting over-pressure will not be exceeded. This is a HOLD POINT.

8.4 CONTROL OF GROUND VIBRATION
Monitoring vibrations
Requirement: Arrange for the monitoring of ground vibrations to ensure compliance with the peak particle velocity limits shown in the Limiting peak particle velocity table. All monitoring to be carried out by personnel possessing current NATA registration for such monitoring.
Total results: Report all test results on NATA endorsed test certificates to include a clear statement as to compliance or non-compliance with the requirements of this Part of the worksection.

Monitoring locations: In general, establish a monitoring location near the perimeter of the structure or building at the point closest to the maximum charge.

Record: Submit a copy of the monitoring record to the Superintendent.

Blasting site relationship: To minimise the risk of peak particle velocity limits being exceeded, develop a blasting site relationship between peak particle velocity, distance and blasting charge. Maximum Instantaneous Charge: For the first blast, set up monitors at not less than five points at varying distances away from the blasting site. The Maximum Instantaneous Charge for the first blast is not to exceed that calculated and certified by an approved explosives specialist. Submit a calculated relationship for Maximum Instantaneous Charge to AS 2187.2, and for future blasting, ground vibration as vector peak particle velocity.

Adjustment of blast design: For subsequent blasts, the MIC and other aspects of blast design may be adjusted provided that further ground vibration monitoring is undertaken and the mean regression line redetermined to demonstrate that peak particle velocity limits are not exceeded.

This is a WITNESS POINT.

### 1113 STABILISATION

#### 1. RESPONSIBILITIES

**Objectives**

General: Provide stabilisation of subgrade and pavement courses using the specified materials and processes as documented.

**Performance**

Requirements: Provide the work in accordance with the specification, standards, quality requirements and approved work plan.

**Design**

Authority requirements: Conform to statutory requirements for Work Health and Safety.

#### 1.2 CROSS REFERENCES

**General**

Requirement: Conform to the following:

- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1141 Flexible pavement base and subbase.
- 1351 Stormwater drainage (Construction).

#### 1.3 REFERENCED DOCUMENTS

**Standards**

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

- AS 1141 Methods for sampling and testing aggregates
- AS 1141.11.1-2009 Particle size distribution – sieving method
- AS 1289 Methods of testing soils for engineering purposes
- AS 1289.4.2.1-1997 Soil chemical tests - Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
- AS 1289.5.7.1-2006 Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method)
AS 1289.5.8.1-2007  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 1289.6.1.1-1998  Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen

AS 2350 Various  Methods of testing Portland and blended cements

AS/NZS 2350.4: 2006  Setting time of Portland and blended cements

AS 2350.9-2006  Determination of residue on the 45 µm sieve

AS 3582  Supplementary cementitious materials for use with portland and blended cement

AS 3582.1-1998  Fly ash

AS 3582.2-2001  Slag - Ground granulated iron blast-furnace

AS 3583  Methods of test for supplementary cementitious materials for use with portland cement

AS 3583.3-1991  Determination of loss on ignition

AS 3583.6-1995  Determination of relative water requirement and relative strength

AS 3583.12-1991  Determination of available alkali

AS 3583.13-1991  Determination of chloride ion content

AS 3583.14-1991  Determination of insoluble residue content

AS 3972-2010  General purpose and blended cements

Other publications

AUSTROADS


AP-C87-2010  Austroads Glossary of terms

NSW RMS Test Methods

T432 – 2001  Rate of slaking of quicklime

1.4 STANDARDS

General

Standard: To AGPT04D.

1.5 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:

Definitions

General: For the purposes of this worksection the following definitions apply:
- Field Working Period: Time period from addition of mixing water until completion of compaction.
- Joints: Interfaces between work episodes delayed by more than the Field Working Period.
- Stabilising agent: Quicklime, hydrated lime, slag/lime blend, cement.

1.6 SUBMISSIONS

Approvals

Submissions: To the Superintendent’s approval.
- Proposed Workplan.
- Stabilisation mix.

Materials: Cement, Quicklime, Hydrated lime, Ground granulated blast furnace slag, Flyash, Blended stabilising agents, Water.

Calculations

General:
- Application rate.
- Unconfined compressive strength.

Execution

- Trial stabilisation.

Documents

Submit the following for 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.

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specified materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRE-CONSTRUCTION PLANNING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials proposed for use in the work</td>
<td>Submit NATA certificate of compliance</td>
<td>14 days prior to commencement of works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Field Working period</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Laboratory</td>
<td>Nominate the specific field working period in annexure A</td>
<td>14 days prior to commencement of works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Storage</td>
<td>Re-test cement stored in excess of 3 months</td>
<td>2 working days prior to usage</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stabilisation processes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Proposed equipment and procedures</td>
<td>Submit a Work Plan nominating proposed plant and work sequence</td>
<td>14 days prior to commencement</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Application of stabilising agent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- In situ application</td>
<td>Proposals for special processes of supply of stabilising agent into the mixing bowl</td>
<td>7 days prior to mixing</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Mixing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- In situ mixing process</td>
<td>Demonstration of equipment mixing efficiency in trial section</td>
<td>7 days prior to production stabilisation</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Trimming and compaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Trimming</td>
<td>Work methods to exclude laminations and slurrying</td>
<td>3 working days prior to production stabilisation</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>- Survey control</td>
<td>Use of trimmed</td>
<td>3 working days prior to</td>
<td>Principal Certifying Authority</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><strong>Methods</strong></td>
<td>material as fill or spoil</td>
<td>disposition</td>
<td>Authority</td>
</tr>
<tr>
<td><strong>Curing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Method statement</strong></td>
<td>Submit details of proposed curing method</td>
<td>As directed</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Trial section of stabilised earthworks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General</strong></td>
<td>Submit a trial section of stabilised earthworks</td>
<td>5 working days prior to commencement of works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>General</strong></td>
<td>Any deficient sections will require to be investigated and may be directed to remove</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table – Off-site activities**

<table>
<thead>
<tr>
<th>Clause/subclause</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>Cement</td>
<td>Proof of quality and source</td>
<td>Progressive</td>
</tr>
<tr>
<td>Quicklime</td>
<td>Proof of quality and source</td>
<td>Progressive</td>
</tr>
<tr>
<td>Hydrated lime</td>
<td>Proof of quality and source</td>
<td>Progressive</td>
</tr>
<tr>
<td>Ground granulated blast furnace slag</td>
<td>Proof of quality and source</td>
<td>Progressive</td>
</tr>
<tr>
<td>Flyash</td>
<td>Proof of quality and source</td>
<td>Progressive</td>
</tr>
<tr>
<td>Blended stabilising agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Standard</td>
<td>Proof of quality and source</td>
<td>Progressive</td>
</tr>
<tr>
<td>- Handling and storage</td>
<td>Comply with supplier’s handling and storage requirements and arrange sampling of agent</td>
<td>Progressive</td>
</tr>
</tbody>
</table>

**Summary of WITNESS POINTS – 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>Quality requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Compaction</td>
<td>Adjustment of Field Working Period for site conditions</td>
<td>Progressive</td>
</tr>
<tr>
<td>Application of stabilising agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Stationary mixing plant</td>
<td>Monitoring application of stabilising agent at the plant</td>
<td>Progressive</td>
</tr>
<tr>
<td>- Stationary mixing plant</td>
<td>Removal of spilled stabilising agent</td>
<td>Immediately upon spillage event</td>
</tr>
<tr>
<td>- Spreading out</td>
<td>Actual spread to be recorded and checked</td>
<td>Progressive</td>
</tr>
<tr>
<td>- Spreading out</td>
<td>Record average spreading rate using load cells</td>
<td>Progressive</td>
</tr>
<tr>
<td>Mixing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Stationary mixing plant</td>
<td>Test unconfined compressive strength</td>
<td>Progressive</td>
</tr>
<tr>
<td>- In situ mixing process</td>
<td>Visual inspection to ensure uniform mixing and record</td>
<td>Progressive</td>
</tr>
</tbody>
</table>
## 2 PRE-CONSTRUCTION PLANNING

### 2.1 SPECIFIED MATERIALS

**Materials proposed for use in the work**

Certificates of compliance: Provide a certificate from a NATA registered laboratory showing the following:

- The stabilisation mix(s) submitted and the mix constituents comply with the mix specified in Annexure A.
- The stabilised material meets the requirements of 1141 Flexible pavement base and subbase if incorporated into the works as a pavement layer or
- 1112 Earthworks (Roadways) or
- 1351 Stormwater drainage (Construction).

This is a HOLD POINT.

**Inspection, sampling and testing**

Quality checks: Regular inspection, sampling and testing of pavement and subgrade materials to be undertaken by the Contractor while stabilisation is in progress in accordance with this worksection.

### 2.2 WORKS GENERALLY

**Provision for traffic**

Protection: Provide for traffic in accordance with 1101 Control of traffic while undertaking the work and take all necessary precautions to protect the work from damage until such time as the new work has developed sufficient strength to carry normal traffic without damage.

Delays: Take all necessary steps to avoid or minimise delays and inconvenience to road users during the course of the work. Where adequate detours or side tracks are included in the contract or are otherwise available, traffic to be temporarily diverted while the work is in progress.

**Proposals for construction**

Program: Plan program of works to address time and access constraints. Develop equipment selection and material sources to suit the sequence of operations. Address the interaction with the Superintendent on approvals and inspections. Generate the Work Plan for Submission.

### 2.3 FIELD WORKING PERIOD

**Laboratory tests**

Submit: Provide the nominated Field Working Period in Annexure A for the stabilising agent approved for the works. This is a HOLD POINT.

Method: The nominated Field Working Period to be based on laboratory tests determining the time from mixing until such time as the calculated Wet Density for standard compaction procedures decreases by more than 2% points.

Samples: This testing to be undertaken utilising AS 1289.5.7.1 and samples of the materials representative of those to be utilised in the works.
Type: The field working period may vary significantly with variations in the type of stabilising agent.

3 MATERIALS

3.1 GENERAL

Stabilisation types: The requirements for stabilisation of the types of pavement courses and subgrade zones or layers are shown in **Types of pavement courses, subgrade zones or layers and stabilising binder** Table. The pavement course or subgrade zone or layer for stabilisation is as specified in 1141 Flexible pavement base and subbase.

<table>
<thead>
<tr>
<th>Pavement course or subgrade zone or layer</th>
<th>Stabilising binder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base and subbase</td>
<td>Cement</td>
</tr>
<tr>
<td></td>
<td>Blended Stabilising Agent</td>
</tr>
<tr>
<td></td>
<td>Hydrated Lime (pugmill)</td>
</tr>
<tr>
<td></td>
<td>Quicklime (in situ)</td>
</tr>
<tr>
<td>Subgrade zone or layer</td>
<td></td>
</tr>
<tr>
<td>Selected Material Zone</td>
<td>Cement</td>
</tr>
<tr>
<td></td>
<td>Blended Stabilising Agent</td>
</tr>
<tr>
<td></td>
<td>Quicklime (in situ)</td>
</tr>
<tr>
<td></td>
<td>Hydrated Lime (pugmill)</td>
</tr>
<tr>
<td>Other Subgrade Layers</td>
<td>Cement</td>
</tr>
<tr>
<td></td>
<td>Blended Stabilising Agent</td>
</tr>
<tr>
<td></td>
<td>Quicklime (in situ)</td>
</tr>
<tr>
<td></td>
<td>Hydrated Lime (pugmill)</td>
</tr>
<tr>
<td>Selected Backfill Zone</td>
<td>Cement</td>
</tr>
<tr>
<td></td>
<td>Hydrated Lime (pugmill)</td>
</tr>
</tbody>
</table>

3.2 CEMENT

**Standard**

General: To AS 3972.
- Testing: To AS 2350 (Various).

Proof of quality: Provide documentary evidence of the quality and source of the cement upon request at any stage of the work. This is a **WITNESS POINT**.

**Storage**

Storage period: Prior to use re-test and submit test results for cement that has been stored for a period in excess of three months from the time of manufacture to ensure the cement still complies with AS 3972. This is a **HOLD POINT**.

Transport: Transport cement in water tight packaging and protect from moisture until used. Do not use caked or lumpy cement.

3.3 QUICKLIME

**Standard**

Type:
- Available lime: To AS 3583.12.
- Temperature rise: To test method RMS T432.
- Particle size: To AS 1141.11.1.

Quality: Provide NATA laboratory test results to confirm that the quicklime supplied conforms with that specified. This is a **WITNESS POINT**.

**Properties**

Calcium oxide: Quicklime to consist of essentially calcium oxide in a highly reactive form. At the point of spread the content of calcium oxide > 85 %.

Slaking rate: The active slaking time ≤ twenty minutes. The temperature rise on slaking > 40°C in 6 minutes (determined from the average of four samples tested in accordance with Test Method RMS T432).
Particle size: The particle size distribution of the quick lime to comply with the following requirements in Table 3.1.

Table 3.1 Particle size distribution of quicklime

<table>
<thead>
<tr>
<th>AS Sieve</th>
<th>Per cent passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.2 mm</td>
<td>100</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>96–100</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>70–100</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>0–90</td>
</tr>
</tbody>
</table>

3.4 HYDRATED LIME

Standard
Type:
- Available lime: To AS 3583.12.
- Fineness: To AS 2350.9.
- Particle size: To AS 3583.14.

Quality: Provide NATA laboratory test results to confirm that the hydrated lime supplied conforms with that specified. Details to include percentage of calcium hydroxide, fineness expressed by percentage by mass passing the 45 \( \mu m \) sieve and source. This is a WITNESS POINT.

Properties
Calcium hydroxide: Hydrated lime to consist essentially of calcium hydroxide > 80 %. Both when used as the sole stabilising agent or blended with other additives.
Form: The material to be in powder form and must be dry.
Residue on sieving (Particle Size): The residue on a 300 \( \mu m \) sieve < 2 %.

3.5 GROUND GRANULATED BLAST FURNACE SLAG

Standard
Type: To AS 3582.2.
- Fineness: To AS 2350.9.
- Relative strength: To AS 3583.6.

Quality: Provide NATA laboratory test results to confirm that the slag supplied conforms with that specified. Details to include fineness expressed by percentage by mass passing the 45 \( \mu m \) sieve, relative strength (28 days) and source. This is a WITNESS POINT.
Slag: Ground granulated blast furnace slag is known as ‘slag’.

3.6 FLYASH

Standard
Type: To AS 3582.1.
- Fineness: To AS 2350.9.
- Loss on ignition: To AS 3583.3.

Quality: Provide NATA laboratory test results to confirm that the flyash supplied conforms with that specified. Details to include fineness expressed by percentage by mass passing the 45 \( \mu m \) sieve, loss on ignition and source. This is a WITNESS POINT.
3.7 BLENDED STABILISING AGENTS

Standard
Type:
- Fineness: To AS 2350.9.
- Setting time: To AS/NZS 2350.4.

Quality: Provide NATA laboratory test results to confirm that the blended agent supplied is in accordance with that specified. Details to include fineness expressed by percentage by mass passing the 45 μm sieve, setting time and source of each component. This is a WITNESS POINT.

Batch information
Requirements: A blended stabilising agent may be used.

Blending mass: The mass of components of the nominated blended stabilising agent are not to vary by more than ± 3 % from the blend percentages nominated in the mix design described in Annexure A.

Handling and storage
Requirements: Comply with the supplier's handling and storage requirements. Also arrange for sampling of the agent as required. This is a WITNESS POINT.

3.8 WATER

Standard
Chloride ion: To AS 3583.13.
Sulphate ion: To AS 1289.4.2.1.

Quality
Water to be free from harmful amounts of materials such as oils, salts, acids, alkalis and vegetable substances. Water accepted as potable and fit for human consumption will not require testing to confirm suitability.

Tolerances: Water not to contain more than:
- 600 parts per million of chloride ion.
- 400 parts per million of sulphate ion.
- 1 % by mass of undissolved solids.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 STABILISATION PROCESSES

Proposed equipment and procedures
Work plan: Submit details of the proposed equipment (including the mixing plant) and stabilisation procedures to be used in the work. This submission will be known as the Work Plan and is to include the following:
- The sequence of operations.
- Widths of stabilisation passes.
- Provision for traffic if appropriate.
- Comply with Statutory requirements for WHS.
- Testing methods and frequency.
- Comply with this worksection.
- Survey control methods.
- Curing methods.

This is a HOLD POINT.
4.3 QUALITY REQUIREMENTS

Compaction
Compaction within Field Working Period: Complete the compaction process within the nominated Field Working Period unless specific approval is provided by the Superintendent to an adjustment for site and seasonal conditions. This is a WITNESS POINT.

Weather conditions
Moisture Content: Do not proceed with the stabilisation of pavement materials during wet weather or if rain is imminent and likely to occur during any stage of the stabilisation process so as to significantly influence the resultant moisture content and uniformity of moisture content in the mix.
Wind: Do not proceed with spreading during windy conditions which may cause loss of stabilising agent or cause nuisance or danger to people or property.

4.4 APPLICATION OF STABILISING AGENT

Stationary mixing plant
Application rate: Monitor the application rate of stabilising agent at the pug mill or equivalent approved plant. Record for every 100 tonnes of production in kg/tonne. This is a WITNESS POINT.
Accuracy: The achieved accuracy of application rate ± 10 % of the rate nominated in Annexure A.
Spillage: Remove any spillage of the stabilising agent on site or at any loading location related to the site as soon as possible and within the same work shift of such spillage. This is a WITNESS POINT.
Excessive application: Prevent excessive application so as not to exceed the nominated rate by more than 10 %.

In situ application
Application process: The incorporation of stabilising agent is to follow a process where it is spread on the pavement in advance of the specialist mixing equipment.
Special processes: Any processes nominated by the contractor involving supply of stabilising agent within the mixing bowl of equipment must be approved. A demonstration of the process at the Contractor’s expense may be requested. This is a HOLD POINT.

Spreading out
Mechanical spreader: Carry out spreading using the approved mechanical spreader nominated in the Work Plan.
Spread rate: Nominated in Annexure A.
Tolerances: The actual spread rate to be within ±10 % of the nominated rate. Verify this by testing the spread rate for each lot or 500 m² of pavement treated (whichever is less) in each application of binder. This is a WITNESS POINT.
Testing: Spread rate testing to be performed by weighing the contents of a suitable 4 sided tray placed on the pavement and between the wheels of the mechanical spreader. Calculate the rate of stabilising agent spread by dividing the mass collected (kg) by the area of the tray (m²).
Average spread rate: Where spreading vehicles are fitted with load cells, ascertain the average spreading rate of the stabilising agent by dividing the mass of the stabilising agent spread per run by the area of the run.
Record: Submit data for each run, however such action will not cancel the Contractor’s obligation to undertake the prescribed testing of spread rate. This is a WITNESS POINT.

4.5 MIXING

Stationary mixing plant
Type: Purpose build the stationary mixing plant for the process of mixing road making materials.
Maintain equipment: Maintain and calibrate all equipment so as to provide a uniformly mixed product without segregation of the aggregate material.
Water addition: Control and meter the inclusion of water into the mix.
Stationary mixing equipment: Incorporate a delivery system for mix materials capable of producing a uniform mixture to design requirements.
Strength test: Confirm performance by monitoring the unconfined compressive strength of production, to conform with AS 1289.6.1.1. Test a pair of specimens for each 100 tonnes of production. This is a WITNESS POINT.
In situ mixing process
Equipment: Mixing equipment and procedure to comply with the following:
- Purpose built for the process of in situ mixing of road making materials.
- Capable of mixing to the depth specified for the layer to be stabilised.
- Distribute the stabilising agent uniformly through the full depth and over the whole area of the layer to be stabilised.
- A minimum of 2 passes of the mixing equipment is required.
- As mixing blades or tynes wear, replace to maintain mixing efficiency consistent with that demonstrated during the trial section.
- Mixing equipment capable of supplying a calibrated amount of water to the mixing bowl in a such manner as to provide a uniformly moist mix to a target moisture content.
Approval: Demonstrate the mixing efficiency. This is a HOLD POINT.
Uniform mixture: The resultant mix must be uniform over the full depth so that there are no lenses, pockets, lumps or granules of stabilising agent present in the layer or adjacent to it.
Work plan: The procedure nominated in the Work Plan is to minimise disturbance of the distribution of stabilising agent spread in advance of the mixing process.
Inspections: Carry out visual inspections during mixing to ensure uniform mixing is being achieved in the layer. Record inspection results to conform with 0161 Quality (Construction) or 0167 Integrated management, as applicable. This is a WITNESS POINT.
Additional mixing: The Superintendent may direct that additional passes by the mixing equipment be carried out to improve the visual uniformity of the mix and/or the moisture content. This is a WITNESS POINT.

4.6 TRIMMING AND COMPACTION
Tolerances
Level tolerance: After mixing, trim and compact the layer to conform with 1141 Flexible pavement base and subbase to produce a tight dense surface parallel with the finished wearing surface so that the levels do not vary from the design levels beyond the tolerance for primary trimming specified in Limits and Tolerances.
Trimming
Secondary trimming: Subsequent secondary trimming may be undertaken on one or more occasions in preparation for primer seal and with the objective of meeting shape and level requirements. Secondary trimming to involve cutting to waste. Work methods that lead to the development of laminations in the pavement will not be allowed and surface slurrying will not be accepted. This is a HOLD POINT.
Survey control methods
General: Provide adequate survey control methods as stated in the Work Plan to ensure that the pavement layer thickness is not reduced during secondary trimming to an extent that it fails to comply with the requirement for layer thickness in accordance with the tolerance specified.
Layer thickness after trimming: When required by the Superintendent provide survey results to confirm that the pavement layer thickness remains within tolerance after secondary trimming. This survey will be at no cost to the Principal. This is a WITNESS POINT.
Trimmed material: All trimmed material having been cut to waste is to be used as fill or spoil as directed. The material will be owned by the Principal. This is a HOLD POINT.
Straight edge test
General: Conform to the following:
- Measurements with a 3 metre straight edge to be taken at a minimum of 10 randomly selected stations so as to represent each 200 metre lane length or part thereof.
- Deviation of the surface from the bottom of a 3 metre straight edge placed in any direction not to exceed 12 mm.
- This testing will be undertaken immediately prior to sealing or prior to agreed practical completion of any work component. This is a WITNESS POINT.
Compaction
General: Compact the stabilised layer over the entire area and depth so that the relative compaction determined by AS 1289.5.7.1 standard compactive effort is not less than as detailed in 1141 Flexible pavement base and subbase, 1112 Earthworks (Roadways) or 1351 Stormwater drainage (Construction), as appropriate.
Test method: To provide true relative compaction assessments the lots will be sampled and tested within the nominated Field Working Period to conform with AS 1289.5.7.1 standard compactive effort.

Wet Density: The maximum wet density (standard compaction) will be determined by sampling immediately after the determination of field density and testing to be undertaken within 2 hours of sampling. A determination of maximum wet density (standard compaction) representing the full layer depth is required for each sampling location when calculation of relative compaction is undertaken.

In situ dry density: The field density may be determined by in situ sand replacement testing or by single probe Nuclear Density Meter in direct transmission mode to conform with AS 1289.5.8.1.

4.7 JOINTS

Joint type
General: Joints comprise interfaces between work episodes that are separated in time by more than the nominal Field Working Period for the nominated stabilisation mix design.
- A longitudinal joint is considered to be a joint generally parallel to the road centreline.
- A transverse joint occurs when a length of work is terminated and extended at a later time after a period which exceeds the nominated Field Working Period.

Cutting back
General: Conform to the following:
- All longitudinal and transverse joints to be formed by cutting back into the previously stabilised and fully compacted sections.
- A minimum longitudinal overlap of mixing runs to be 75 mm.
- Transverse joints to be overlapped by a minimum of 2 m.
- Remix the material disturbed during cutting back at full depth and incorporate into the new work.
- No longitudinal joints to be allowed within 0.5 m of the centreline of a typical wheelpath.

Finish: The level and shape of the joints to be within the limits specified in Limits and Tolerances.

4.8 DIMENSIONS

Levels and surface trim
Surface levels: Conform to the following:
- The surface level after primary trimming + 30 mm and + 10 mm of the levels shown on the drawings.
- The surface level after secondary trimming + 15 mm and - 15 mm of the levels shown on the drawings.
- The pavement surface after secondary trimming and immediately prior to sealing to be of a quality such that deviation under a 3 metre straight edge does not exceed 12 mm.
- Ensure the final surface level is within ± 15 mm of the design levels in the event only a single trim is carried out.

Layer thickness
Layer thickness: Conform to the following:
- The final thickness of the stabilised layer at any point tolerance of + 20 mm and - 10 mm of the nominated layer thickness.
- The average thickness of the layer in a lot is determined from measurements of six randomly selected locations over any 200 m length of a lot and not less than that required to meet the specified final thickness tolerances after trimming.
- The layer thickness is measured at the edges of the stabilising run before compaction commences and measured relative to the finished design level.

Width
General: Conform to the following:
- The minimum width measured at any point of the stabilised layer must not be less than the specified width as shown in the drawings by more than 50 mm.
Average width of the layer determined from measurements at 3 sites selected at random by the Superintendent over any 200 m length of a lot and not less than the specified width. This is a **WITNESS POINT**.

### 4.9 CURING

**Method statement**

Requirement: Submit to the Superintendent details of the proposed method of curing as part of the Work Plan. This is a **HOLD POINT**.

**Curing method**

Water curing: Protect the stabilised work against rapid drying out by keeping it continuously wet or damp during the period prior to the provision of a subsequent layer or the application of a prime or primer-seal. Water curing to consist of frequent light uniform spraying that will not produce significant run off or flooding on sections of the area. Avoid slurring of the surface or leaching of the stabilising agent.

Curing Period: Under this Worksection provision for curing up to the period indicated in Annexure A is the responsibility of the Contractor at cost to the Contractor.

### 4.10 TRIAL SECTION OF STABILISED EARTHWORKS

**General**

Submit: Prior to the commencement of works submit a trial section of Stabilised earthworks to demonstrate the methods proposed to conform with this worksection. This is a **HOLD POINT**.

Trial section: This section is constructed so that it may be incorporated in the finished work. The length approximately 100 m.

Materials and methods: Construct the trial stabilisation using the materials, equipment and methods for placing and finishing the same as would be used for the entire base works. Demonstrate the methods proposed to be used for the construction of joints.

Deficient trial section: In the event of deficiencies in the stabilisation the trial section may not be approved. The method, equipment, materials and personnel will require to be reviewed and an explanation submitted. A further length of stabilisation may be requested. This is a **HOLD POINT**.

Requirement: Remove rejected works and make good any damage.

Removal: Remove the non conforming trial stabilised earthworks ensuring to prevent damage to the remaining stabilised earthworks and underlying materials.

Dispose: Dispose of the removed materials at an approved location.

Payment: Payment made for the stabilisation at the schedule rates for appropriate pay items, if it has been constructed without deficiencies and is incorporated into the work.

### 4.11 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</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Quicklime</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Available lime</td>
<td>&gt; 85% Calcium Oxide content</td>
<td>Quicklime</td>
</tr>
<tr>
<td>- Slaking rate</td>
<td>Active Slaking time &lt; twenty minutes, and temperature rise on slaking &gt; 40°C in 6 minutes (for an average of four samples).</td>
<td>Quicklime</td>
</tr>
<tr>
<td>- Particle distribution</td>
<td>Fraction passing AS Sieve: 100% for 13.2 mm, 96-100% for 9.5 mm, 70-100% for 4.75 mm, 0-90% for 2.36 mm</td>
<td>Quicklime</td>
</tr>
<tr>
<td><strong>Hydrated lime</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Available lime</td>
<td>&gt; 80% Calcium Hydroxide</td>
<td>Hydrated lime</td>
</tr>
<tr>
<td>Activity</td>
<td>Limits/Tolerances</td>
<td>Worksection Clause</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>-Particle size</td>
<td>&lt; 2% residue on a 300 µm Sieve</td>
<td></td>
</tr>
<tr>
<td>Blended stabilising agents</td>
<td>Blend percentages to not vary by more than ± 3% from those nominated in Annexure A</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Chloride ion content</td>
<td>&lt; 600 PPM Chloride ion</td>
<td>Water</td>
</tr>
<tr>
<td>-Sulphate ion content</td>
<td>&lt; 400 PPM Sulphate ion</td>
<td>Water</td>
</tr>
<tr>
<td>-Undissolved solids</td>
<td>&lt; 1 percent by mass of undissolved solids</td>
<td>Water</td>
</tr>
<tr>
<td>Application of stabilising agent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Spread rate or incorporation rate for in situ plant.</td>
<td>Actual spread rate shall be within ± 10% of the nominated rate</td>
<td>Application of stabilising agent</td>
</tr>
<tr>
<td>Trimming and compaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Surface level</td>
<td>After primary trimming be within + 30 mm and +10 mm of levels shown on drawings</td>
<td>Dimensions</td>
</tr>
<tr>
<td></td>
<td>After secondary trimming be within ± 15 mm of levels shown on drawings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Final surface level ± 15 mm of design levels</td>
<td></td>
</tr>
<tr>
<td>-Shape</td>
<td>Not to deviate more than 12 mm under a 3 m straight edge immediately prior to first sealing</td>
<td>Dimensions</td>
</tr>
<tr>
<td>-Layer thickness</td>
<td>Final thickness of layers not to vary more than + 20 mm and - 10 mm of required thickness</td>
<td>Dimensions</td>
</tr>
<tr>
<td>Width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Width of stabilised layer</td>
<td>At any point, the width to be not less than 50 mm short of the width shown on the drawings with an average width always greater than that shown on the drawings</td>
<td>Dimensions</td>
</tr>
<tr>
<td>Joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Longitudinal joint overlap</td>
<td>&gt; 75 mm overlap of mixing runs</td>
<td>Joints</td>
</tr>
<tr>
<td>-Transverse joint overlap</td>
<td>&gt; 2 m overlap of transverse joints</td>
<td>Joints</td>
</tr>
<tr>
<td>-Longitudinal joints</td>
<td>Not within 0.5 m of the centreline of a typical wheelpath</td>
<td>Joints</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

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 1113.1 to 1113.2 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:
- No account to be taken of allowable tolerances or overlaps.
- Except that where stabilisation is provided by use of stationary plant the supply of the material including the stabilisation service and stabilising agent is measured and paid to conform with 1141 Flexible pavement base and subbase or 1112 Earthworks (Roadways), as appropriate,
for supply of the material as a pre-mix product. Supply in these circumstances includes all testing.

- Supply, spread and compact subbase, or base material is measured and paid to conform with 1141 Flexible pavement base and subbase.
- Supply, spread and compact select material is measured and paid to conform with 1112 Earthworks (Roadways).
- Control of traffic is measured and paid 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>1113.1 Supply stabilising agent (in situ mixing only)</td>
<td>Tonne</td>
<td>Calculate for each type and quantity of each stabilising agent to be used. All costs associated with the supply and delivery of the stabilising agent, including testing in accordance with this worksection.</td>
</tr>
<tr>
<td>1113.2 Spread and mixing of stabilising agent</td>
<td>m²</td>
<td>Determine the area by the length and width of work as specified on the drawings or as directed by the Superintendent. Depth of stabilisation to be shown on drawings or as directed by the Superintendent. All costs associated with the spreading and mixing of the stabilising agent with the designated materials in-situ and to the nominated depth in accordance with this worksection.</td>
</tr>
</tbody>
</table>

6 ANNEXURE A

6.1 STABILISATION MIX DESIGN

<table>
<thead>
<tr>
<th>Type of stabilising agent</th>
<th>Nominal percentage of stabilising agent by mass</th>
<th>Spread rate of stabilising agent for contractual purposes</th>
<th>Depth of compacted layer to be stabilised</th>
<th>Nominated Field Working Period</th>
<th>Nominated target unconfined compressive strength (UCS) (7 day accelerated curing)</th>
<th>Nominated target CBR value (4 day soaked) for stabilised modified subgrade</th>
<th>Period for contractor's curing</th>
<th>Nominated granular material(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(kg/m²)</td>
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<td>%</td>
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</tr>
</tbody>
</table>

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1121 Open drains including kerb and channel (gutter)

Source of nominated granular material ..........................................

1121 OPEN DRAINS INCLUDING KERB AND CHANNEL (GUTTER)

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide all types of open drains including unlined and lined open drains, kerb and/or channel (gutter) and rock filled wire mattresses and gabions, as documented.

Performance
Requirements: Construct open drains to the specification and dimensions shown on the drawings.

Design
Designer: [complete/delete]

Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0257 Landscape – roadways and street trees.
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation (Construction).
- 1352 Pipe drainage.

1.3 REFERENCED DOCUMENTS

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

AS 1141 Methods for sampling and testing aggregates
AS 1141.22-2008 Wet/dry strength variation
AS 1289 Methods of testing soils for engineering purposes
AS 1289.5.4.1-2007 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.6.1-1998 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material
AS 2758 Aggregates and rock for engineering purposes
AS 2758.4-2000 Aggregate for gabion baskets and wire mattresses
AS 2876-2000 Concrete kerbs and channels (gutters)—Manually or machine placed
AS/NZS 4534: 2006 Zinc and zinc/aluminium-alloy coatings on steel wire

Other publications
AUSTROADS
AGPT04B Guide to pavement technology Part 4B - Asphalt
AGPT04G/09-2009 Guide to Pavement Technology Part4G- Geotextiles and geogrids
ASTM A975 – 2011 Standard specification for double-twisted hexagonal mesh gabions and revet mattresses (metallic coated steel wire or metallic coated steel wire and PVC coatings)
1.4 INTERPRETATION

Definitions
General: For the purposes of this worksection the following definitions apply:
- Kerb and channel (gutter): Includes all forms of concrete channels (gutters), dish drains, grated drains, and mountable median and barrier kerbing.
- Open drains: All drains other than pipe and box culverts and include catch drains, channels (gutters) and kerbs and channels (gutters).

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.

Documents
General: Submit the following documents for approval:
- Calculations:
  . Proposals for temporary drainage and changed hydraulic capacity.
- Design:
  . Temporary works details.
  . Traffic guidance scheme.
  . Temporary drainage plan.
  . Road opening permit.
- Drawings:
  . Locations of driveways and laybacks.
  . Gully pit hydraulic capacity.
- Execution:
  . Trial section.

Manuals: [complete/delete]
- Technical data:
  . Components for concrete materials and drainage structures, material for backfill, rock filled gabions, pipe work and precast products.
  . Compaction data on earth materials as specified.
  . Materials for gabions and mattress mesh, concrete in situ/precast, pipes.
- Calculations:
  . Survey set-out data for gradients and table drains.
- Technical data:
  . Compaction data on earth materials as specified.
  . Survey data for construction to tolerances.

Type tests: [complete/delete]
- Type test results.
  . Data on extrusion / slip forming performance as required.

Prototypes: [complete/delete]

Samples: [complete/delete]

Warranties: [complete/delete]

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>Authority Approvals</td>
<td></td>
<td></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>
<td>----------------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>Provision for traffic</td>
<td>Submit Traffic Guidance Scheme for approval</td>
<td>2 weeks prior to site commencement</td>
<td>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>MATERIALS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete</td>
<td>NATA compliance certificates for concrete and constituents</td>
<td>7 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Joint Fillers and sealants</td>
<td>NATA compliance certificates for proposed joint filler</td>
<td>7 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Proprietary Products</td>
<td>Submit proprietary products and manufacturers instructions</td>
<td>7 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Wire mattresses</td>
<td>NATA compliance certificates for proposed wire mattress</td>
<td>7 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Gabions</td>
<td>NATA compliance certificates for proposed Gabions</td>
<td>7 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Rock fill material</td>
<td>NATA compliance certificates for proposed rock fill material</td>
<td>7 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Geotextile</td>
<td>NATA compliance certificates for proposed Geotextile material</td>
<td>7 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>EXECUTION</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open drains</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation</td>
<td>Approval to divert drain to avoid trees and/or rocks.</td>
<td>1 working day before set-out.</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Excavation</td>
<td>Location and construction of drains to prevent salination</td>
<td>1 working day before set-out.</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Kerb and channel (gutter)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foundation</td>
<td>Approval for shape and compaction of foundation material.</td>
<td>1 working day before forming</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Construction</td>
<td>Submit details of proposed method</td>
<td>14 days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Trial section</td>
<td>Demonstrate the capability of forming equipment</td>
<td>3 working days prior to commencement on site</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Backfilling and reinstatement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gully pits</td>
<td>Submit details for fixing to existing works for approval</td>
<td>1 working day before demolition</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>
### Clause title/Item

**Requirement**

**Notice for inspection**

**Release by**

| - Gully pits | Hydraulic capacity changes | 7 days prior to commencement on site | Principal Certifying Authority |

### WITNESS POINTS table – On-site activities

#### Clause title/Item

**Requirement**

**Notice for inspection**

<table>
<thead>
<tr>
<th>EXECUTION</th>
<th>Open drains</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Excavation</td>
<td>Unsuitable material removal and disposal</td>
</tr>
<tr>
<td>- Excavation</td>
<td>Spoil site locations</td>
</tr>
<tr>
<td>- Embankment</td>
<td>Embankment compaction and revegetation</td>
</tr>
<tr>
<td>- Construction</td>
<td>Grade and compaction of open drains</td>
</tr>
<tr>
<td>- Construction</td>
<td>Proprietary items installed to manufacturers recommendations</td>
</tr>
<tr>
<td>- Types</td>
<td>Maintain catch drains</td>
</tr>
<tr>
<td>- Types</td>
<td>Construct minor diversion and contour drains, table drains, swales and depressed medians</td>
</tr>
<tr>
<td>- Types</td>
<td>Channels preserving the existing stream bed</td>
</tr>
</tbody>
</table>

### Lining

| - Concrete lining | Instruction on weephole location. |
| - Concrete lining | Joints and tolerances |
| - Stone pitching | Bedding material and placement |

### Kerb and channel (gutter)

| - Stormwater outlets | Direction for other than flexible pipework |
| - Vehicular or pedestrian access | Laybacks confirmation |

### Backfilling and reinstatement

| - Backfill behind kerbs | Backfilling timing, material and compaction |
| - Pavement backfill | Backfill adjacent new gutter material and location |
| Rock filled wire mattresses and gabions – Completion | Inspection of rockfill material and filling method |

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2 PRE-CONSTRUCTION PLANNING

2.1 AUTHORITY APPROVALS

Provision for traffic
Documentation: Submit a Traffic Guidance Scheme for control of vehicular and pedestrian traffic to conform with 1101 Control of traffic. Construct the works with the least possible obstruction to traffic, both vehicular and pedestrian. This is a HOLD POINT.

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:
- Ascertain the location of services.
- Opening and compaction specifications.

2.2 ESTABLISHMENT

Documentation
Survey control: Required for the following:
- Mapping and pegging the drainage system.
- Locating components.

3 MATERIALS

3.1 CONCRETE

General
Standard: To AS 2876
Specification: Concrete properties and delivery, placing, compaction, finishing, curing and protection to conform with 0319 Minor concrete works.
Documentation: Submit NATA registered Compliance Certificates for all constituents of the mix as verification of the mix suitability. This is a HOLD POINT.

3.2 JOINT FILLERS AND SEALANTS

General
Documentation: Submit preformed joint filler proposed for use at least 7 days prior to use in the works. Supply NATA registered compliance certificates. This is a HOLD POINT.

3.3 PROPRIETARY PRODUCTS

General
Approval: Use only proprietary products to conform with the manufacturers instructions. This is a HOLD POINT.

3.4 WIRE MATTRESSES

General
Standard: To ASTM A975.
Submit: For approval the type of mattress proposed and a schedule of locations. This is a HOLD POINT.
Dimension: Unless otherwise shown on the drawings. 6 m × 2 m × 230 mm. Cut to suit areas if required.
Diaphragms: Divide mattress into cells not exceeding 1 m centres.
Forming diaphragms: Folding the base layer of a mattress, provided that the bottom of each of the diaphragm halves is securely tied together so that the transmission of tensile forces in the mesh of the base layer is not impeded.
Mattress material: Flexible woven heavily galvanised wire to ASTM A975.
Mesh size: 60 × 80 mm.
Galvanizing: Coating mass for round wire Class W10 to AS/NZS 4534. 95% zinc 5% aluminium mischmetal alloy.
Body wire: 2.0 mm minimum core diameter.
PVC wire coating: 0.4 mm required as shown on the drawings.
Selvedge wire: 2.4 mm minimum core diameter for mattresses less than 350 mm thick.
Mattresses between 350 mm and 550 mm minimum diameter of mesh must be 2.4 mm and minimum galvanized wire 3.0 mm.
Selvedge properties: Ensure the mesh does not unravel and that the strength of the connection between the selvedge wire and the mesh ≥ the breaking strength of the mesh.
Lacing wire: 2.2 mm minimum core diameter.

3.5 GABIONS

General
Standard: To ASTM A975.
Submit: For approval the type of mattress proposed and a schedule of locations. This is a HOLD POINT.
Dimension: As shown on the drawings.
Diaphragms: Divide gabion into cells not greater than the width of the gabion plus 100 mm.
Material: Flexible woven heavily galvanised wire to ASTM A975.
Mesh size: 80 x 100 mm nominal.
Galvanizing: Coating mass for round wire Class W10 to AS/NZS 4534. 95% zinc 5% aluminium mischmetal alloy.
Body wire: 2.7 mm minimum core diameter.
PVC wire coating: 0.4 mm required as shown on the drawings.
Selvedge wire: 3.4 mm minimum core diameter.
Selvedge properties: Ensure the mesh does not unravel and that the strength of the connection between the selvedge wire and the mesh ≥ the breaking strength of the mesh.
Lacing wire: 2.2 mm minimum core diameter.

3.6 LACING AND CONNECTING WIRE

General
Standard: To ASTM A975.
Minimum diameter: 2.2 mm
Alternative fasteners: ‘C’ clips conforming with ASTM A975 may be used if approved.

3.7 ROCK FILL MATERIAL

General
Standard: To AS 2758.4.
Rock quality: Clean, dense, durable hard rock.
Wet strength: > 100 kN to AS 1141.22.
Wet / dry strength variation: < 35% to AS 1141.22.
Submit: For approval rock material and NATA certificates of compliance of the proposed rock fill material. This is a HOLD POINT.
Particle sizes for wire mattresses: Between 75 mm and two-thirds of the mattress thickness, or 250 mm, whichever is the lesser.
Particle size for gabions: Between 100 mm and 250 mm and preferably not greater than 200 mm.

3.8 GEOTEXTILE

General
Submit: For approval the proposed geotextile material and NATA certificates of compliance.
Submit a sample of the fabric, the manufacturer information and installation instructions. This is a HOLD POINT.
Type: As shown on the drawings.
Properties
Classification: Properties, functions, design and construction requirements to AUSTROADS AGPT04B/09.
Specification: Material type and minimum mass requirements as shown on the drawings.
Quality: Free of any flaws, stabilised against UV radiation, rot proof, chemically stable, low water absorbency. Filaments must resist delamination and maintain their relative dimensional stability.
Geotextile strength and filtration: Require a knowledge of the site soils including gradings, plasticity and strength, protection of the layers supporting the drains.
Robustness and strength: Conform to the following:
- Conform to the classifications for robustness and strength cited in AGPT04G/09.
- Select material based on tests and subgrade conditions for the relevant location/function.

**Delivery and storage**
Delivery: At least 14 days prior to commencement of installation.
Storage: Under protective cover or wrapped with a waterproof, opaque UV protective sheeting to avoid any damage prior to installation. Store to conform to manufacturers recommendations.
Damage: Must not be stored directly on the ground or in any manner that adversely effect the material by heat, dirt or damage.
Label: Ensure the geotextile material is clearly labelled showing manufacturer, type and batch number.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 OPEN DRAINS

Excavation
Clear: To 1111 Clearing and grubbing, strip topsoil and any unsuitable material.
Trees and rock outcrops: Approval to divert the drain where trees marked for preservation or rock outcrops occur. This is a HOLD POINT.
Control of erosion: Conform to 1102 Control of erosion and sedimentation (Construction).
Salinity prevention: Locate and construct open drains to avoid recharging groundwater, a shallow water table and salinity degradation of adjacent land. This is a HOLD POINT.
Excavate: To the dimensions shown on the drawings or where not shown to minimum depth of 300 mm and minimum waterway area 0.2 m².
Cross section: V-shaped or trapezoidal unless otherwise shown on drawings.
Batter slope: Not steeper than 2H:1V.
Unsuitable material: Notify the Superintendent of any unsuitable material and seek a direction for removal. Dispose of the unsuitable material as approved or directed. Replace unsuitable material with acceptable cut or other material. This is a WITNESS POINT.
Surplus material: Use the excavated material in the works or remove to spoil stockpiles as directed. This is a WITNESS POINT.
Waterways outside the site: Do not disturb with activities associated with the work.

Embarkment
Construct: In layers maximum 200 mm in depth and compact in layers of maximum depth 150 mm.
Compaction of excavated material: Not less than 95% for standard compactive effort to AS 1289.5.4.1.
Revegetation: Vegetate the embankment after its completion to 0257 Landscape – roadways and street trees.
Backfill: To excavation below the level of the natural channel with suitable material. Compact to a density equal to and compatible with that existing naturally. This is a WITNESS POINT.

Construction
Discharge: Extend open drains to natural drainage depressions, culverts, or pits connected to underground drainage systems. Follow existing watercourses and depressions in the natural surface.
Trimming: To a uniform surface free of irregularities and compact any surface to be lined to 90% relative compaction.
Open drains: Grade to ensure free flow of water and minimum grade of 0.5%. This is a WITNESS POINT.

Types
Provide catch drains: Before construction of the adjacent roadway.
Location of catch drains: > 2 m above the tops of cuttings or > 2 m along the toes of embankments.
Maintain: The fall of the catch drains unless otherwise approved. This is a WITNESS POINT.
Minor diversion and contour drains: Provide the same capacity as the nearest pipe culvert on the line of the drain.

Table drains, swales and depressed medians: Construct as part of earthworks, with the line and level as shown on the drawings or from calculations. This is a WITNESS POINT.

Channels: Excavate inlet, outlet and diversion channels as shown on the drawings and, unless noted otherwise, extend to join the existing stream bed, avoiding disturbance in stream flow. Preserve the existing stream bed as far as possible outside the limits of the excavation. This is a WITNESS POINT.

4.3 LINING

General
Lining choice: Unless otherwise shown on the drawings use the following linings:
- Organic fibre mat and vegetation where the longitudinal grade of the completed drain lies between 1% and 5% inclusive; or
- Concrete where the longitudinal grade of the completed drain is less than 1% or greater than 5%.

Timing: Within 7 days of shaping and compacting the foundation.

Proprietary Items: Install approval proprietary items to conform to the manufacturer’s instructions. This is a WITNESS POINT.

Organic fibre mat and vegetation
Conform to: 0257 Landscape – roadways and street trees.

Concrete lining
Concrete: Minimum compacted thickness 100 mm measured at right angles to the surface of the lining.
Colour: To match that of the surrounding materials or as directed.
Method: Cast-in-situ or sprayed concrete to conform with 0319 Minor concrete works.

Weepholes: Provide weepholes in locations shown on the drawings or at 2 m spacing in non-horizontal elements or as directed. This is a WITNESS POINT.

Top of finished lining: True to line and of uniform width, free from humps, sags or other irregularities.

Tolerances: Conform to the following limits:
- Finished levels of lining surface: Within ± 10 mm of design levels.
- Surface deviation: Not more that 5 mm from a 3 m straight edge parallel to the direction of flow, except at kerb laybacks, grade changes or curves, or at gully pits requiring channel depression.

Contraction joints: Conform to the following:
- Width: 5 mm minimum.
- Depth: 20 mm minimum.
- Intervals: Every 3 m of lining.

Expansion joints: Conform to the following:
- Width: 15 mm.
- Depth: Full thickness of the concrete lining.
- Intervals: 15 m maximum.
- Material: Approved preformed jointing material. This is a WITNESS POINT.

Stone pitching
Material: Sound durable rock not less than 100 mm thick, properly bedded on approved loam or sand and mortared to present a uniform surface.
The exposed surface of each stone: Approximately flat and not less than 0.05 m² in area.
Spaces between adjacent stones or blocks: 20 mm maximum width. This is a WITNESS POINT.

Batter drains
Material: Half round steel pipes or precast nestable concrete units as shown on the drawings.
Install: The units in a carefully excavated and template controlled trench to form an even top edge +0 mm to −50 mm from the batter line at the underside of topsoil.
Backfill and compact: Backfill over-excavation and undulations in the batter line. Compact both sides of the drain over the full length to form a firm shoulder against the top edge of the batter drain.
Taper topsoil: Over a width of 1 m to zero thickness at the rim of the drain.
1121 Open drains including kerb and channel (gutter)

Turf: Both sides of the drain for a minimum width of 600 mm to conform with 0257 Landscape – roadways and street trees.

4.4 KERB AND CHANNEL (GUTTER)

Foundation
Shape and compaction: Before placing any kerb and/or channel (gutter), shape and compact the foundation material to an approved firm base.
Relative compaction: To AS 2876 except where placed on pavement courses, then to the requirements of the respective pavement course. This is a HOLD POINT.

Construction
Construct: Kerb and/or channel (gutters) in fixed forms, by extrusion or by slip forming to AS 2876. Submit: Details of method proposed including type of extrusion or slipform, concrete properties, equipment and finish. This is a HOLD POINT.

Trial section
Trial section: Provide a trial section to demonstrate the Contractors capability of forming equipment. This is a HOLD POINT.

Finish
Finish true to line: The top and face of the finished kerb and channel.
Top surface: Uniform width, free from humps, sags and other irregularities.
Type: Steel float finish or as otherwise shown on drawings.

Tolerances
Finished levels of channel / gutter surface: Within ± 10 mm of design levels.
Surface deviation of kerb face and channel (gutter) surface: ± 5 mm from the edge of a 3 m straight edge, except at kerb laybacks, grade changes or curves, or at gully pits requiring channel/gutter depression.

Joints
Contraction joints: Unless shown otherwise on the drawings, conform to the following:
- Width: 5 mm minimum.
- Depth: 20 mm.
- Intervals: Every 3 m of channel / gutter length for a minimum of 50% of cross sectional area of concrete.
- Tooling: 20 mm in depth to form a neat groove of 5 mm minimum width.
Expansion joints: Provide where the channel/gutter abuts against pits, retaining walls, overbridges and at both sides of kerb laybacks for vehicular or pedestrian access. Unless shown otherwise on the drawings, conform to the following:
- Width: 15 mm.
- Depth: Full depth of kerb and channel (gutter).
- Maximum intervals: 15 m.
Joints adjacent to concrete pavement: If kerbs and/or channel / gutters are cast adjacent to a concrete pavement, continue the contraction, construction and expansion joints documented for the concrete base across the kerb and/or channel (gutter).

Stormwater outlets
General: Reconnect and extend all existing house stormwater outlets through the kerb to match the existing type and size of pipe as shown on the drawings.
Pipes: Conform to 1352 Pipe drainage. This is a WITNESS POINT.

Vehicular or pedestrian access
Barrier kerb: Discontinue opposite all driveways as shown on the drawings or as directed.
Kerb laybacks: As shown on the drawings where the barrier kerb is discontinued.
Footpath crossovers: Meet the laybacks as shown on the drawings or reinstate to match existing materials. This is a WITNESS POINT.

4.5 BACKFILLING AND REINSTATEMENT

Backfill behind kerbs
Timing: Not earlier than 3 days after concreting, backfill and reinstate the spaces on both sides of the kerb and/or channel (gutter) to conform with the drawings, or as directed.
Material: Granular material, free of organic material, clay and rock in excess of 50 mm diameter, or approved material.
Layers: Compact in layers not greater than 150 mm thick.
Relative compaction: 95% when tested in conformance with AS 1289.5.4.1 for standard compactive effort or density index 70 if non-cohesive material to AS 1289.5.6.1. Surface treatment: Free draining and free from undulations and trip hazards. This is a WITNESS POINT.

Pavement backfill
Backfill: Material adjacent to the new channel (gutter) as shown on the drawings or as directed. This is a WITNESS POINT.

Gully pits
Reconstruct: The top of gully pits or adjust precast units to suit new kerb and channel (gutter) profile to conform with 0319 Minor concrete works.
Adjustment: Demolish and reconstruct gully pits to suit new line or level of the kerb and channel (gutter) to match the design standard of the existing gully pit.
Fixing to existing works: Fix new wall sections in concrete or brick securely to the retained wall section. Submit details of the proposed procedure for approval. This is a HOLD POINT.
Hydraulic capacity: Retain or improve the capacity of the original gully pit. Cavity shapes to be regular and oriented so as not to impede flow into and out of the pit.
Submit: Provide sketches and/or calculations relevant to such hydraulic capacity. This is a HOLD POINT.

4.6 ROCK FILLED WIRE MATTRESSES AND GABIONS

General
Location: As shown on the drawings.

Foundations
Finished level of excavation: Prior to installation of rock filled wire mattress or gabion excavate so the mattresses finish flush with the surrounding ground.
Shape and compaction: Not less than 95 % for standard compactive effort to AS 1289.5.4.1. to form a uniform channel cross-section prior to installation of mattresses.
Geotextile: Before laying out the wire mattresses or gabions, place geotextile between the wire cage and the material being protected as shown on the drawings.

Assembly
Prior to assembly: Open the wire mesh out flat on the ground and stretch it to remove all kinks and bends.
Gabion boxes: Individually assemble by raising the sides, ends and diaphragms, ensure all creases are in the correct position and that all four sides and the diaphragms are even.
Lace: The four corners first and then the edges of internal diaphragms to the sides.
Lacing and twisting: Commence the lacing by twisting the end of the lacing wire around the selvage(s) then pass it around the two edges being joined using alternate single and double loops through each mesh in turn and tie it off securely at the bottom.
Ends: Turn the ends of all lacing wires to the inside of the box on completion of each lacing operation.

Erection
Conform to the following:
- Only assembled boxes, or groups of boxes must be positioned in the structure.
- Secure the end to either the completed work or by galvanised star pickets driven into the ground at 1 m spacing.
- Firmly embed the star pickets into the ground by minimum 900 mm.
- Star pickets to be at lest the height of the box.
- Place boxes in the structure lacing securely the proceeding one along all common corners and diaphragms.
Stretching for gabion boxes: Using a pull lift of at least 1 tonne capacity, firmly secured to the free end of the assembled gabion boxes. Whilst under tension, securely lace the gabion boxes along all edges and at diaphragm points to adjacent boxes.
Mattresses: Adjust the position of the diaphragms so that the sides hinge up on the thicker wire woven in the mesh.

Filling
Gabion boxes: Conform to the following:
- Fill whilst the gabion boxes are under tension.
- Place the rocks at the front face and other exposed faces by hand to produce a neat face free of excessive bulges, depressions and voids.
- Internal bracing wires 4 per m$^3$ at 330 mm centres to prevent distortion.
- Face bracing wires 4 per m$^2$ of face.
- Mechanical filling equipment may be used with caution to protect any PVC or galvanized coatings from abrasion.
- Release the tension on the gabion boxes only when fully laced so as to prevent any slackening.

Mattresses:
- Mechanical filling equipment may be used with caution to protect any PVC or galvanized coatings from abrasion.
- Redistribute the filling materials by hand to ensure that all diaphragm compartments are fully filled to produce a neat and level top surface.
- Overfill by 25 to 50 mm to allow for subsequent settlement.

**Final lacing**
Close and lace lids: As soon as practicable after filling particularly if there is a storm or flood expected.
Stretch lids tightly over the filling and lace down securely.

**Completion**
Inspection: Inspection of rock fill material and filling method. This is a WITNESS POINT.

### 4.7 LIMITS AND TOLERANCES

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>Materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wire mattresses</td>
<td>Diaphragm cells at 1 m centres</td>
<td>Wire mattresses</td>
</tr>
<tr>
<td></td>
<td>Mesh size 60 x 80 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Galvanising 95% zinc, 5% aluminium</td>
<td></td>
</tr>
<tr>
<td>Gabions</td>
<td>Diaphragms &lt; width plus 100 mm</td>
<td>Gabions</td>
</tr>
<tr>
<td></td>
<td>Mesh size 80 x 100 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Galvanising 95% zinc, 5% aluminium</td>
<td></td>
</tr>
<tr>
<td>Rock fill material</td>
<td>Wet strength &gt; 10 kN</td>
<td>Rock fill material</td>
</tr>
<tr>
<td></td>
<td>Wet/dry strength &lt; 35%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Particle size for mattresses between 75 mm and 150 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Particle size for gabions &gt; 100 mm &lt; 250 mm</td>
<td></td>
</tr>
<tr>
<td>Unlined open drains</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td>Grade &gt; 0.5%</td>
<td>Open drains – Construction</td>
</tr>
<tr>
<td></td>
<td>Depth &gt; 300 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Waterway Area &gt; 0.2 m$^2$</td>
<td></td>
</tr>
<tr>
<td>Catch Drain Location</td>
<td>&gt; 2 m from top of cuttings or toes of embankments</td>
<td>Open drains - Types</td>
</tr>
<tr>
<td>Lining</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1% to 5% use organic mat or vegetation</td>
<td>Lining</td>
</tr>
<tr>
<td></td>
<td>Less 1% greater than 5% use concrete lining</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Concrete 100 mm thick measured at right angles</td>
<td>Concrete lining</td>
</tr>
</tbody>
</table>
# 1121 Open drains including kerb and channel (gutter)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contraction joints</td>
<td>Width: 5 mm minimum</td>
<td>Concrete lining</td>
</tr>
<tr>
<td></td>
<td>Depth: 20 mm minimum</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intervals: every 3 m of lining</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tooling: 20 mm in depth groove 5 mm minimum width</td>
<td></td>
</tr>
<tr>
<td>Expansion joints</td>
<td>Width: 15 mm minimum</td>
<td>Concrete lining</td>
</tr>
<tr>
<td></td>
<td>Depth: full thickness of the concrete lining</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Intervals: 15 m maximum</td>
<td></td>
</tr>
<tr>
<td>Stone pitching</td>
<td>Rock &gt; 100 mm thick</td>
<td>Stone pitching</td>
</tr>
<tr>
<td></td>
<td>Exposed surface &gt; 0.05 m²</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Spaces &lt; 20 mm maximum width</td>
<td></td>
</tr>
<tr>
<td>Batter drains</td>
<td>Install 0 to 50 mm below batter line</td>
<td>Batter drains</td>
</tr>
<tr>
<td></td>
<td>Top soil: thickness 1 m to 1 at rim of drain</td>
<td></td>
</tr>
<tr>
<td>- Compaction of Foundation</td>
<td>&gt; 95% (standard compaction)</td>
<td>Lined open drains</td>
</tr>
<tr>
<td>- Level of lining surface</td>
<td>Level ± 10 mm of design level</td>
<td>Concrete lining</td>
</tr>
<tr>
<td>- Surface uniformity</td>
<td>Deviation lining surface from 3 m straight edge ≤ 5 mm</td>
<td>Concrete lining</td>
</tr>
</tbody>
</table>

## Kerb and channel

<table>
<thead>
<tr>
<th>Kerb and channel (gutter)</th>
<th>Execution</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Relative compaction of foundation</td>
<td>To AS 2876</td>
</tr>
<tr>
<td>- Finished levels of channel (gutter) surface</td>
<td>Level ± 10 mm of design level</td>
</tr>
<tr>
<td>- Surface deviation of kerb face and channel (gutter) surface</td>
<td>± 5 mm from 3 m straight edge</td>
</tr>
<tr>
<td>- Contraction joints</td>
<td>Width: ≥ 5 mm</td>
</tr>
<tr>
<td></td>
<td>Depth: 20 mm</td>
</tr>
<tr>
<td></td>
<td>Intervals every 3 m of channel/gutter length for a minimum of 50% of CS area of concrete</td>
</tr>
<tr>
<td>- Expansion joint interval</td>
<td>≤ 15 m</td>
</tr>
<tr>
<td></td>
<td>Width: 15 mm</td>
</tr>
<tr>
<td></td>
<td>Depth: Full depth of kerb and channel (gutter)</td>
</tr>
<tr>
<td>Backfill behind kerb</td>
<td>≤ 150 mm</td>
</tr>
<tr>
<td>- Layer thickness</td>
<td></td>
</tr>
<tr>
<td>- Relative compaction</td>
<td>95% (standard compaction)</td>
</tr>
</tbody>
</table>

## Rock filled wire mattresses and gabions

<table>
<thead>
<tr>
<th>Rock filled wire mattresses and gabions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- Star pickets for ties</td>
<td>Depth in ground &gt; 900 mm</td>
</tr>
<tr>
<td></td>
<td>Spacing &lt; 1 m</td>
</tr>
<tr>
<td>Bracing wires</td>
<td>Internal: 4 per m² at 330 mm centres</td>
</tr>
<tr>
<td></td>
<td>Face: 4 per m² of face</td>
</tr>
<tr>
<td>Wire mattress filling</td>
<td>Over fill mattresses by 25 to 50 mm</td>
</tr>
</tbody>
</table>

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## 5 MEASUREMENT AND PAYMENT

### 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 1121.1-1121.8 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: In conformance with 1102 Control of erosion and sedimentation (Construction).
- Sprayed concrete lining of open drains: In conformance with 0319 Minor concrete works.
- Cast-in-situ concrete or other lining of open drains: 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 0319 Minor concrete works.
- Topsoiling and turfing to sides of batter drains: In conformance with 0257 Landscape – roadways and street trees.

### 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>1121.1 Excavation—catch, contour and minor diversion drains</td>
<td>Linear metre measured along the invert of the drain.</td>
<td>All costs associated with: - Excavation of all types of material. - Does not include separate rates for earth and rock. - Placement and compaction of material excavated from the drains on the lower sides of the drains to form banks in the excavation rates. - Temporary measures for the control of stormwater runoff.</td>
</tr>
<tr>
<td>1121.2 Excavation—inlet, outlet and diversion channels</td>
<td>m³ measured from cross sections on the drawings using the end area method, or as ‘each’ where minor work is involved.</td>
<td>All costs associated with: - Excavation of all types of material. - Does not include separate rates for earth and rock. - The disposal of surplus material. - Temporary measures for the control of stormwater runoff.</td>
</tr>
<tr>
<td>1121.3 Concrete lining of open drains</td>
<td>m² of concrete in place.</td>
<td>All costs associated with: - Surface preparation, supply and placing of concrete, jointing and curing.</td>
</tr>
<tr>
<td>1121.4 Stone pitching of open drains</td>
<td>m² of stone pitching in place.</td>
<td>All costs associated with: - Surface preparation, supply of stone, placing, final trimming and mortar jointing.</td>
</tr>
<tr>
<td>1121.5 Batter drains</td>
<td>Linear metre along the length of the drain formed by batter drain units.</td>
<td>All costs associated with: - Supply of the units, excavation, installation, backfilling and compaction.</td>
</tr>
<tr>
<td>1121.6 Rock filled gabions</td>
<td>m³ of rock filling.</td>
<td>All costs associated with: - Rock volumes taken from the drawings and adjusted for any authorised changes. - Supply and placement of geotextile material behind the gabions - Supply and assembly of the gabions - Supply and placing of the rock fill in 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>1121.7 Rock filled wire mattresses</td>
<td>m² of rock filled mattress complete.</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Area determined from the actual completed work including the area folded into the</td>
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<tr>
<td></td>
<td></td>
<td>trench.</td>
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<tr>
<td></td>
<td></td>
<td>- Supply and placement of geotextile material, star pickets and ties.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply and assembly of the wire mattresses.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Supply and placing of the rock fill.</td>
</tr>
<tr>
<td>1121.8 Kerb and/or channel (gutter)</td>
<td>Linear metre measured along the length</td>
<td>All costs associated with:</td>
</tr>
<tr>
<td></td>
<td>of the kerb and/or channel including</td>
<td>- Compaction of foundations, forming, concreting.</td>
</tr>
<tr>
<td></td>
<td>kerb laybacks and perambulator ramps.</td>
<td>- Expansion and contraction joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Backfilling and compaction adjacent to the completed kerb.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Separate pay items for each type of kerb and/or channel.</td>
</tr>
</tbody>
</table>
1132 LEAN MIX CONCRETE SUBBASE

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide lean mix concrete subbase and associated components, as documented.

Performance
Requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation.
- 1112 Earthworks (Roadways).
- 1133 Plain and reinforced concrete base.

1.3 REFERENCED DOCUMENTS

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

Australian standards
AS 1012 Methods of testing concrete
AS 1012.1-1993 Sampling of fresh concrete
AS 1012.3.1-1998 Determination of properties related to the consistency of concrete - Slump test
AS 1012.3.3-1998 Determination of properties related to the consistency of concrete - Vebe test
AS 1012.4.2-1999 Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1-2000 Method for making and curing concrete - Compression and indirect tensile test specimens
AS 1012.9-1999 Determination of the compressive strength of concrete specimens
AS 1012.13-1992 Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory
AS 1012.14-1991 Method for securing and testing cores from hardened concrete for compressive strength
AS 1141 Methods for sampling and testing aggregates
AS 1141.5-2000 Particle density and water absorption of fine aggregate
AS 1141.6.1-2000 Particle density and water absorption of coarse aggregate - Weighing-in-water method
AS 1141.11.1-2009 Particle size distribution – sieving method
AS 1141.12-1996 Materials finer than 75 µm in aggregates (by washing)
AS 1141.13-2007 Material finer than 2 µm
AS 1141.14-2007 Particle shape, by proportional calliper
AS 1141.18-1996 Crushed particles in coarse aggregate derived from gravel
AS 1141.22 -2008 Wet/dry strength variation
AS 1141.24-1997 Aggregate soundness - Evaluation by exposure to sodium sulfate solution
AS 1141.35-2007 Sugar

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AS 1160-1996  Bituminous emulsions for the construction and maintenance of pavements
AS 1289  Methods of testing soils for engineering purposes
AS 1289.3.6.3-2003  Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis using a hydrometer
AS 1289.4.2.1-1997  Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1379-2007  Specification and supply of concrete
AS 1478  Chemical admixtures for concrete, mortar and grout
AS 1478.1-2000  Admixtures for concrete
AS/NZS 1554.3:2008  Structural steel welding – Welding of reinforcing steel
AS 2758  Aggregates and rock for engineering purposes
AS 2758.1-1998  Concrete aggregates
AS 3582  Supplementary cementitious materials for use with portland and blended cement
AS 3582.1-1998  Fly ash
AS 3583  Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13-1991  Determination of chloride ion content
AS 3600-2009  Concrete structures
AS 3799-1998  Liquid membrane—forming curing compounds for concrete
AS 3972-2010  General purpose and blended cements
AS/NZS 4671:2001  Steel reinforcing materials
AS/NZS 4680:2006  Hot-dipped galvanized (zinc) coatings on fabricated ferrous articles
SAA HB 155 – 2002  Guide to the use of recycled concrete and masonry materials
Austroads
AGPT04C – 2009  Guide to pavement technology part 4C: Materials for concrete road pavements
AGPT04E - 2009  Guide to pavement technology part 4E: Recycled materials
AGPT04G - 2009  Guide to pavement technology part 4G: Geotextiles and geogrids
AGPT04J – 2008  Guide to pavement technology part 4J: Aggregate and source rock
AGPT08-2009  Guide to Pavement Technology Part 8: Pavement construction
Other
ARRB Group  Specification for Recycled Crushed Glass as an Engineering Material
NSW RMS  QA Roadworks Specification R83 for Jointed Concrete Base

1.4 STANDARDS
General
Standards: To AS 1379, AS 3600, AGPT08 and AGPT04C.

1.5 INTERPRETATION
Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
CRCP: Continuously reinforced concrete.
JRCP: Jointed reinforced concrete.
PCP: Jointed plain concrete.
SFCP: Jointed steel fibre reinforced concrete pavement.
Definitions
General: For the purposes of this worksection the following definitions apply:
- Lot: A continuous placement of up to 50 m$^3$ 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 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>DESIGN AND CONTROL OF CONCRETE MIX</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nominated mix</td>
<td>Submit details of concrete mix and materials including NATA certificates and test results</td>
<td>21 working days before ordering concrete</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Variations to nominated mix and materials</td>
<td>Submit details of any change to nominated mix and materials</td>
<td>21 working days before implementing change</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SITE ESTABLISHMENT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subgrade survey</td>
<td>Submit work-as-executed survey of the subgrade.</td>
<td>2 working days before starting</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>TRIAL LEAN MIX CONCRETE SUBBASE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>Inspection of the trial lean mix concrete subbase</td>
<td>At least 5 working days before starting the subbase works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Deficient trial section</td>
<td>Submit methods used in producing deficient work for assessment</td>
<td>1 working day after deficiency identified</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Non-conforming trial section</td>
<td>Submit changes proposed for construction of new trial section</td>
<td>At least 5 working days before starting the subbase works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>PRODUCTION, TRANSPORT AND DELIVERY</strong></td>
<td>Submit proposed work methods</td>
<td>21 working days before starting</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>CONCRETE PLACING AND FINISHING</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment and methods</td>
<td>Submit details of proposed equipment, methods and paving plan</td>
<td>21 working days before starting</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Acceptance criteria for subbase thickness</td>
<td>Submit subbase survey</td>
<td>Within 2 working days of completing concrete works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH</strong></td>
<td>Inspection of sampling procedure</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Acceptance criteria</td>
<td>Submit test results</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Acceptance criteria for cored concrete</td>
<td>Submit test results</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>REMOVAL AND REPLACEMENT OF SUBBASE</strong></td>
<td>Submit proposed method of removal</td>
<td>7 working days before removal</td>
<td>Principal Certifying Authority</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>General</td>
<td>Submit proposed method of removal</td>
<td>7 working days before removal</td>
</tr>
<tr>
<td>Clause title/Item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
</tr>
<tr>
<td>-------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CEMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage and transport</td>
<td>Test the cement stored for longer than 3 months</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>AGGREGATES</strong></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><strong>STEEL REINFORCEMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Provide test certificates</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Concrete delivery</td>
<td>Keep record of the delivery information</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>SUBGRADE BEAMS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Provide subgrade beams</td>
<td>7 working days before concrete placement</td>
</tr>
<tr>
<td>Excavation</td>
<td>Inspection of subgrade beams excavation profile</td>
<td>2 working days before concrete placement</td>
</tr>
<tr>
<td><strong>CONCRETE PLACING AND FINISHING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment and methods</td>
<td>Give 7 days notice before starting</td>
<td>7 working days</td>
</tr>
<tr>
<td>Consistency</td>
<td>Provide consistency test results</td>
<td>Progressive</td>
</tr>
<tr>
<td>Ground surface conditions</td>
<td>Provide damp, clean and compacted ground surface</td>
<td>Progressive</td>
</tr>
<tr>
<td>Ambient conditions</td>
<td>Protect concrete when cold or hot weather and when it rains</td>
<td>Progressive</td>
</tr>
<tr>
<td>Evaporation and moisture loss</td>
<td>Prevent moisture loss when evaporation rate exceeds prescribed limits</td>
<td>Progressive</td>
</tr>
<tr>
<td>Paving in general</td>
<td>Provide base slab anchors if required</td>
<td>Progressive</td>
</tr>
<tr>
<td>Paving continuity</td>
<td>Provide a construction joint if paving is disrupted</td>
<td>Progressive</td>
</tr>
<tr>
<td>Alignment and surface tolerances</td>
<td>Remediation of surfaces above or below level tolerances</td>
<td>Progressive</td>
</tr>
<tr>
<td>Acceptance criteria for subbase thickness</td>
<td>Remove insufficiently thick subbase</td>
<td>As directed</td>
</tr>
<tr>
<td><strong>JOINTS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>Inspection of joints</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>CURING AND DEBONDING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application of curing compound</td>
<td>Check application rate with a nominated lot</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>CONCRETE CRACKING</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-conforming concrete</td>
<td>Treatment as directed by Superintendent</td>
<td>Progressive</td>
</tr>
<tr>
<td>Treatment of spalling</td>
<td>Treatment as directed by Superintendent</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing by specimens cut from the work</td>
<td>Cut cores in the presence of the Superintendent</td>
<td>Progressive</td>
</tr>
<tr>
<td>Clause title/Item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>----------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Remedial work after coring</td>
<td>Advise proposed method of restoration</td>
<td>Progressive</td>
</tr>
<tr>
<td>REMOVAL AND REPLACEMENT OF SUBBASE</td>
<td>Damage pavement adjacent rejected subbase</td>
<td>As directed</td>
</tr>
</tbody>
</table>

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 and WITNESS POINTS.

2.2 DESIGN AND CONTROL OF CONCRETE MIX

Nominated mix
General: Before starting the production of the concrete for subbase 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 grading for combined aggregate.
  - Curing compounds: Application rate.
- Concrete mix design.
- Test results and certificates of conformance for the proposed 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.
Submission type: HOLD POINT.
Non-conformance: Consider any change without approval to a material in the approved mix as a non-conforming material. Concrete containing this material may become non-conforming concrete.
3 MATERIALS

3.1 CEMENT

General
Standard: To AS 3972.

Storage and transport
Storage: Store cement bags under cover and above ground.
Storage time: Re-test cement that has been stored for longer than three months.
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: Provide water with less than:
- 300 parts per million of chloride ion, determined by AS 3583.13.
- 400 parts per million of sulfate ion, determined by 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 to conform to the manufacturer’s recommendations.
Compatibility of admixtures: Provide certificate from the manufacturer for combinations of two or more admixtures.

Types of admixtures
Warm season retarder: To control slump within the limits stated in Consistency during the warm season, (October to March inclusive), use a lignin or lignin-based (‘ligpol’) set-retarding admixture (Type Re or Type WRRe).
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).
Alkali contribution: For concrete mix with less than 50 kg/m$^3$ fly ash, the total alkali contribution (measured as Na$_2$O) from all admixtures used in any mix must not exceed 0.20 kg/m$^3$.
Types: Superplasticisers and high range water reducers (type HR, WR, Re) may be used.

3.5 AGGREGATES

General
Properties: All aggregate to AS 2758.1, AGPT04J and the following;
- Samples for testing: From dedicated stockpiles or from materials delivered to site.
- Chloride and sulfate ion contents: Less than 0.8 kg/m$^3$ and 5% respectively.
- Soluble salt content assessment: Maximum 12 months before closing of tenders.
Requirement: Clean, durable materials sourced from natural gravel, crushed stone, air-cooled iron blast furnace slag and sand. Do not use steel-plant slag.

Reycled concrete aggregate
Course aggregates from demolition concrete: To the recommendations of SAA HB155 and AGPT04E.
Blending: If blending coarse recycled concrete aggregate with natural aggregates make sure substitution rates are below 30%.
Recycled crushed glass

Requirement: Meet the recommendations of the ARRB Group in Specifications for Recycled Crushed Glass as an Engineering Material and all other technical criteria for fine aggregate.

Blending: Maximum of 30% by mass of the total fine aggregate.

Additional properties for fine aggregate

General: To the Fine aggregate properties table.

Fine aggregate properties table

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
<th>Test method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Density</td>
<td>1200 kg/m³ minimum</td>
<td>AS 1141.4(1)</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>5.0% maximum, except slag aggregate: 6.0%</td>
<td>AS 1141.5 and AS 1141.6.1</td>
</tr>
<tr>
<td>Material finer than 75 µm</td>
<td>Maximum 10.0 %</td>
<td>AS 1141.12</td>
</tr>
<tr>
<td>Material finer than 2 µm</td>
<td>Maximum 1.0 %</td>
<td>AS 1141.13</td>
</tr>
<tr>
<td>Soundness</td>
<td>12 % max weighted average loss</td>
<td>AS 1141.24</td>
</tr>
<tr>
<td>Organic impurities</td>
<td>Maximum 0.5 %</td>
<td>AS 1289.4.1.1</td>
</tr>
<tr>
<td>Sugar content</td>
<td>Less than 1 part in 10,000</td>
<td>AS 1141.35</td>
</tr>
</tbody>
</table>

Notes: (1) ‘Bulk density’ in AS 2758.1 means the same as ‘unit mass’ in AS 1141.4.

Sodium sulfate soundness: Do not exceed the limits shown in the Sodium sulfate soundness limits table as determined by AS 1141.24.

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: If two or more fine aggregates are blended, apply the above limits to each constituent material.

Grading: Provide fine aggregate and grading determined by AS 1141.11.1 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>± 5</td>
</tr>
<tr>
<td>300 µm</td>
<td>8–25</td>
<td>± 2</td>
</tr>
<tr>
<td>150 µm</td>
<td>1–8</td>
<td>-</td>
</tr>
<tr>
<td>75 µm</td>
<td>0–3</td>
<td>-</td>
</tr>
</tbody>
</table>

Additional properties for coarse aggregate

General: To the Coarse aggregate properties table.

Coarse aggregate properties table

<table>
<thead>
<tr>
<th>Property</th>
<th>Specification limits</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulk Density</td>
<td>1200 kg/m³ minimum</td>
<td>AS 1141.4(1)</td>
</tr>
<tr>
<td>Water absorption</td>
<td>Slag: 6 % max</td>
<td>AS 1141.6.1</td>
</tr>
<tr>
<td>Material finer than 75 µm</td>
<td>Maximum 2.0 %</td>
<td>AS 1141.12</td>
</tr>
</tbody>
</table>
Material finer than 2 μm | Maximum 1.0 % | AS 1141.13
--- | --- | ---
Particle shape, 2:1 and 3:1 ratios | Maximum 35 % and 10 % | AS 1141.14
Wet strength | Minimum 50 kN | AS 1141.22
Wet/dry strength variation | Maximum 35 % | AS 1141.22
Soundness - loss in mass | Maximum 9.0% | AS 1141.24
Fractured faces (two or more) | Minimum 80% | AS 1141.18

Notes: *(1) 'Bulk density' in AS 2758.1 means the same as 'unit mass' in AS 1141.4.*

Grading: Provide course aggregate with grading determined by AS 1141.11.1 within the limits given in the Coarse aggregate grading table.

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>± 2</td>
</tr>
<tr>
<td>19.00 mm</td>
<td>95–100 (accepted design mix)</td>
<td>± 5</td>
</tr>
<tr>
<td>13.20 mm</td>
<td>25–55</td>
<td>± 5</td>
</tr>
<tr>
<td>9.50 mm</td>
<td>0–10</td>
<td>± 3</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>0–2</td>
<td></td>
</tr>
<tr>
<td>2.36 mm</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Storage

Storage areas: Locate the storage area to prevent the aggregates becoming intermixed or mixed with foreign materials or segregated.

Inspection type: **WITNESS POINT.**

### 3.6 CURING AND SURFACE DEBONDING COMPOUNDS

**General**


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

**www.concrete.net.au** Curing compounds and debonding

<table>
<thead>
<tr>
<th>Type</th>
<th>Suitability with bituminous/asphaltic surfacing</th>
<th>Base type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing surface</td>
<td>No wearing surface</td>
<td></td>
</tr>
<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>
</tr>
<tr>
<td>Water borne hydrocarbon resin or styrene butadiene resin (SBR) conforming with AS 3799 Class Z. *</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Bitumen emulsion grade CRS/170 conforming to AS 1160. *</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>White pigmented wax emulsion Class A Type 2. *</td>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Debonding bitumen sprayed seal with 7 mm aggregate</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes:

* For paving in NSW from November to March, use a Type 2 compound which contains a titanium dioxide reflective pigment. At all other times, use a Type 1-D compound.
3.7 STEEL REINFORCEMENT

General
Standard: To AS/NZS 4671.
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.
Certification: Provide test certificates for the steel reinforcement to AS/NZS 4671.
Activity type: WITNESS POINT.
Bar chairs: 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 without malfunction.
Galvanised bars: Hot dipped to AS/NZS 4680.

3.8 CONCRETE QUALITY REQUIREMENTS

Compressive strength
Minimum compressive strength:
- At 7 days: 4 MPa.
- At 28 days: 5 MPa.
Maximum compressive strength:
- At 28 days: 15 MPa.
- For drying shrinkage less than 400 µε: 20 MPa.
Testing: To TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH.

Drying shrinkage
Standard: To AS 1012.13.
Maximum drying shrinkage after 21 days air drying:
- 450 µε if maximum aggregate size > 20 mm.
- 550 µε if maximum aggregate size ≤ 20 mm.

Consistency
Standard: To AS 1012.3.1.
Slump range:
- For mechanically placed concrete: 25 mm to 40 mm.
- For hand placed concrete: 50 mm to 65 mm.
Slipform concrete mix: Vebe reading of the trial mix to AS 1012.3.3.

Air content
Standard: To AS 1012.4.2.
Maximum air content of fresh concrete: 5.0 ± 2.0%.

Special circumstances
Approval: If concrete qualities do not conform to the above, provide approval before ordering concrete.

3.9 CONCRETE FOR SUBGRADE BEAMS

General
Strength: 32 MPa normal class to conform to AS 1379.
Aggregate size: Maximum nominal size 20 mm.
Slump at the point of placement: 50 to 80 mm.

3.10 BINDER CONTENT FOR LEAN MIX CONCRETE

General
Binder content: The hydraulic, cementitious binder content to conform to the following table:

<table>
<thead>
<tr>
<th>Mix Category</th>
<th>Flyash (kg/m³)(1)</th>
<th>Cement (kg/m³)(1)</th>
<th>Total binder (kg/m³)(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subbase</td>
<td>100 minimum</td>
<td>90 minimum</td>
<td>250 minimum</td>
</tr>
</tbody>
</table>

(1) per yielded cubic metre of concrete
4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 SITE ESTABLISHMENT

Subgrade survey
Measure the subbase 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 work-as-executed survey of the subgrade 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 LEAN MIX CONCRETE SUBBASE

Construction
Requirement: Before starting the paving works, construct a trial section of lean mix concrete subbase as follows:
- Incorporate the trial section into the subbase works.
- Construct separate trial sections for each subbase type.
- Length:
  - 50 m to 100 m for mechanical placing.
  - 15 m to 50 m for manual placement.
- Width: Same as proposed for the work.
Materials and methods: Construct the trial lean mix concrete subbase using the materials, concrete mix, equipment and methods for the entire subbase works.
Inspection: Notify the Superintendent for inspection of the completed trial lean mix concrete subbase.
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 subbase, review the method, equipment, materials and personnel and submit a report.
Submission type: HOLD POINT.
Non-conforming trial section
General: If the trial concrete subbase 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 subbase and make good any damage caused by such removal.
- Construct the new trial subbase in conformance with REMOVAL AND REPLACEMENT OF SUBBASE.
Inspection type: HOLD POINT.

4.4 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.

4.5 SUBGRADE BEAMS

General
Location: Provide below the subbase at expansion joints and isolation joints in the concrete base as shown in the drawings or as directed. Construct subgrade beams before the subbase.
Inspection type: **WITNESS POINT**.
Extent: Full length of joints or as shown on the drawings.

Excavation
Dimensions and levels: Excavate to the dimensions shown on the drawings. Finish the top surface of the subgrade beam level with the top of the subgrade.
Method: Remove all loose material and trim the vertical faces to neat lines. Re-compact the bottom of the trench as required, to the degree of consolidation of the adjacent undisturbed material.
Inspection type: **WITNESS POINT**.

Concrete
Minimum compressive strength at 28 days: 32 MPa.

Steel reinforcement
Conform to the following:
- Reinforcement dimensions and shapes as shown on the drawings.
- Bent to an internal bend radius at least twice the diameter of the bar.
- Do not bend or straighten in a manner that will damage the material.
- Do not use with kinks or bends not shown on the drawings.
- Do not heat for the purpose of bending.
Bar splicing: Fabricate all reinforcement in the lengths indicated on the drawings. Splice to conform to the drawings. Obtain approval for any additional splicing by location and method.
Plan lengths: Conform to the following for length of lapped splices for unhooked bars not shown on the drawings will be as follows:
- Plain bars, Grade 250: 40 bar diameters.
- Deformed bars, Grade 500: 40 bar diameters.
- Hard-drawn wire: 50 bar diameters.
- Reinforcement fabric: Overlap between the outermost wire in each sheet of fabric transverse to the direction of the splice greater than the pitch of the transverse wires plus 25 mm.
Lapped splices: The ends of the bars forming a lapped splice must be welded or securely wired together in at least 2 places. Welding to conform to AS/NZS 1554.3.
On-site bending: Do not use heat for bending of reinforcement.

Construction and protection
Voids: If any loose material is removed, fill the voids with mortar or concrete and screed to provide a surface flush with the top of the subgrade beam.
Finish: Use a steel float to produce a smooth surface finish, free of any texture.
Protection: Protect from damage by plant, motor vehicles and the paving operation.
Curing: Cure the top surface of the subgrade beam before placing the subbase.
Bond breaker: Apply to the top surface of the subgrade beam, 24 to 72 hours before placing of subbase concrete.
4.6 CONCRETE PLACING AND FINISHING

**Equipment and methods**
Proposal: Submit the full details of the equipment and methods proposed for placing and finishing the concrete subbase, 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 subbase on any section of work including the trial subbase.
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.
Consistency check: Perform slump test on each truckload of concrete.
Slump tolerances:
- ± 10 mm for slipformed concrete.
- ± 15 mm for manually placed concrete.
Test results: Provide all consistency test results.

**Ground surface conditions**
General: Provide ground surface for the concrete subbase that is damp, clean and free of loose or foreign matter and compacted.
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 for the measures used or cease work.
Inspection type: WITNESS POINT.
Evaporation retarder: If an evaporation retarder is used 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 in this example.

Paving in general

Surface finish:
- Generally: Steel screed or float finish.
- For asphaltic base or concrete base with bitumen seal: Hessian dragged finish.
- For concrete base without bitumen seal: Smooth surface without dimpling, ridges or recesses.

Base slab anchors: During construction of the subbase, make provision for the construction of base slab anchors at the locations shown on the drawings.

Inspection type: WITNESS POINT.
Paving continuity
Continuity: Make sure the supply of concrete and the concrete paving operation are continuous so that the mechanical paver is not stopped due to lack of concrete.
Disruptions: If disruptions occur in mechanical or hand paving, form a construction joint before restarting the paving operations.
Inspection type: WITNESS POINT.

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.

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

Hand placing
Restriction: Use hand placement only in areas where mechanical placement is not practical.
Obtain approval before starting the works.
Formwork: Provide formwork as follows:
- Designed and constructed so that it can be removed 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.
Standby vibrators: Require minimum of 1 standby vibrator and ¼ of the vibrator number in use.
Vibrators: Not less than 1 internal vibrators for each 10 m3 of concrete placed per hour. For paving widths greater than 2.5 m a minimum of 2 vibrators must be used.
Screed: Compact and finish the slab by at least 2 passes of a hand guided vibratory screed traversing the full width of the slab on each pass.

Alignment and surface tolerances
Outer edge: Construct outer edges of the subbase to be square to the subgrade and 50 mm wider than the plan position of the base formation with a tolerance of ± 25 mm.
Longitudinal construction joint: If an edge of a slab is to form a longitudinal construction joint line to conform to Longitudinal construction joints for the allowable horizontal alignment tolerances.
Subbase tolerance: +0 mm to –20 mm deviation from the design level.
Finished surface tolerance: ± 5 mm deviation from a 3 m straight edge.
Remedial works: Remove concrete found to be above level. If concrete is found to be below level tolerance, make it up with base concrete.
Inspection type: WITNESS POINT.

Acceptance criteria for subbase thickness
Subbase survey: Perform survey level runs after the placement of subbase, taken on a 5 m grid on the plan area. Round off the measurements to the nearest 5 mm.
Subbase thickness determination: Assess the subbase thickness by comparing the subbase survey to **SITE ESTABLISHMENT, Subgrade survey**.
Requirement: Submit work as executed survey of the subbase to the full extent of works. Highlight locations where the actual level is higher or lower than the design levels.
Submission type: **HOLD POINT**.
Verification of subbase thickness: Cut concrete cores from the pavement edge if directed by the Superintendent.
Accepted tolerance: Accept subbase which is 10 mm or less below the theoretical thickness if it represents isolated sections within a lot and such sections comprise less than 5% of the area of the lot.
Non-conforming thickness: After making due allowance for the tolerances, remove the subbase which is more than 20 mm below the theoretical thickness.
Inspection type: **WITNESS POINT**.

**Protection of work**
Traffic restrictions: Do not allow traffic or construction equipment, other than that associated with testing, on the subbase until the strength of the subbase has reached at least 4.0 MPa.
Damage: Rectify any damage caused to the subbase.

### 4.7 JOINTS

**General**
Inspection: Inspect the location and condition of all joints.
Inspection type: **WITNESS POINT**.

**Transverse construction joints**
General: Conform to the following:
- Do not scabble.
- Provide only at discontinuities in the placement of concrete determined by paving operations.
- Construct normal to the edge line and as shown on the drawings.
- 10 mm maximum deviation from a 3 m straightedge with due allowances for any planned curvature.
- Make smooth across the joint.

**Longitudinal construction joints**
General: Conform to the following:
- Do not scabble.
- Form within 100 mm of the base longitudinal joints or as shown in the drawings.
- 20 mm maximum deviation from the plan or nominated position.
- 10 mm maximum deviation from a 3 m straightedge with due allowances for any planned curvature.
- Make smooth across the joint.
- Make perpendicular to the subgrade surface.

### 4.8 CURING AND DEBONDING

**Application of curing compound**
Application method: Fine spray immediately following the surface finishing.
Minimum application rate: As stated on the certificate of conformance or at the following rates, whichever rate is the greater.
- Generally: 0.2 litres/m².
- Bitumen emulsion: 0.5 litres/m² of residual bitumen.
- Hand application: Increase the rates by 25%.
Calculations of application rate: Calculate the amount of curing compound applied to a measured area of a lot nominated by the Superintendent.
Inspection type: **WITNESS POINT**.
Requirement: If the base consists of asphaltic concrete, do not use wax emulsion curing compounds.
Curing period: Maintain the curing membrane intact for seven days after placing the concrete.
Damage: Make good any damage to the curing membrane by hand spraying of the affected areas.
Application of bond breaker
Preparation: Immediately before the application of bond breaker, clean the subbase surface of all loose, foreign and deleterious material.
Application rate: Minimum of 0.2 litres/m².
Timing: Apply the bond breaker within the following time frame:
- After the subbase has achieved strength of 4.0 MPa.
- After the subbase level schedules have been completed.
- Within 49 days of placement of the subbase or within 14 days of the achievement of strength conformity, whichever occurs first.
- After the curing compound is applied.
- Minimum 72 hours before placement of the base.
Type of curing compound: If wax emulsion is used, make sure this is the same wax emulsion as used for curing.

4.9 CONCRETE CRACKING

Typical subbase cracks
Definition: Full-depth transverse cracks continuous for the full width of the paving run at approximately 3-15 m centres.
Remedial work: Not required.

Plastic shrinkage cracks
Definition: Discrete cracks of length less than 300 mm and a depth less than 50 % of the slab thickness that do not intersect a formed edge.
Remedial work: To Corrective action.

Additional longitudinal and transverse cracks
Definition: Other than typical subbase cracks and plastic shrinkage cracks with cumulative length of cracking in excess of 2 m in any 25 m² area of subbase.
Remedial work: To Corrective action.

Corrective action
Strain alleviating membrane strip: Apply 300 mm minimum width geotextile backed polymer modified bitumen strip over the crack before the placement of the first asphalt base layer or concrete base.
Installation: To manufacturer’s recommendations and AGPT04G.
Wax emulsion: Provide double application of wax emulsion for a width of 300 mm along the crack when a concrete base is required.

Non-conforming concrete
Criteria: Remove and replace subbase if one or more of the following occurs:
- Transverse cracks over 300mm in length at average spacing of less than 2 m over a length of 5 metres.
- Longitudinal cracks for a contiguous length exceeding 5 m.
- Cracks over 300 mm in length within a distance of 1.5 m from a construction joint, isolation joint or free edge.
Inspection type: WITNESS POINT.

Treatment of spalling
Preparation of subbase: Immediately before the treatment, clean the subbase surface of all loose, foreign and deleterious material to the satisfaction of the Superintendent. Wet the area and sprinkle with neat cement.
Inspection type: WITNESS POINT.
Treatment method: If the spalled area is greater than 10 mm deep and 15 mm wide infill the area with 6:1 sand/cement mortar and screed the surface flush with the surrounding concrete.
Spalling repair time: Complete treatment no earlier than five working days before the application of the bond breaker.

4.10 TESTING OF CONCRETE FOR COMPRESSIVE STRENGTH

Sampling, curing and testing of fresh concrete
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**.
Moulding: Mould at least two test specimens from each sample to AS 1012.8.1. Supply the number of moulds required for the documented frequency of testing.
Curing: Carry out initial curing on site between 18 to 36 hours. Inspect, cap and mark specimens for identification before sending to testing laboratory.
Transport: Do not transport specimens within 3 hours of being cast.
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.
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 subbase concrete strength is non-conforming, request permission to core the in situ subbase 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 subbase 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 subbase. 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 to 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>
<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.
Remedial work after coring
Restoration: Advise proposed method of restoration.
Inspection type: WITNESS POINT.

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 SUBBASE.

4.11 REMOVAL AND REPLACEMENT OF SUBBASE

General
Non-conforming subbase: Remove rejected subbase and replace to conform to this clause.
Replace rejected subbase, which extends more than 25 m longitudinally by mechanical means unless the slabs are odd-shaped or mismatched.
Proposed method: Submit details of the proposed methods of carrying out the work that will prevent damage to the adjoining subbase.
Submission type: HOLD POINT.

Subbase sawcuts
Transverse sawcut:
- Make a transverse sawcut the full depth of the subbase layer at each end of the section of subbase to be removed.
- Make the sawcut normal to the control line.
- Do not over-saw into the adjoining base or underlying sub base.

Longitudinal sawcuts:
- Locate the cut 150–300 mm offset from planned longitudinal contraction joints in the overlying base.
- Do not to extend more than 250 mm past the transverse sawcut at each end of the section to be removed.

Over-sawing: Do not over-saw on any additional internal sawcuts made to aid the removal of the subbase.

Removal and replacement
Disposal: Dispose the removed subbase slabs.
Damage to adjoining pavement: Remove and replace any pavement adjacent to the original area of rejected subbase damaged by the operations.
Inspection type: WITNESS POINT.
Replacement of bondbreaker: After construction of the replacement subbase, prepare and debond the pavement in conformance with this worksection.

4.12 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/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials for concrete</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Properties for coarse aggregates</td>
<td>To the Coarse aggregate properties table</td>
<td>AGGREGATES, Additional properties for coarse aggregate</td>
</tr>
<tr>
<td>Aggregates grading</td>
<td>Deviation from submitted sample not greater than Fine aggregate grading table</td>
<td>AGGREGATES, Additional properties for fine aggregate</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><strong>Concrete</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drying Shrinkage at 21 days:</td>
<td>Maximum aggregate size &gt; 20 mm</td>
<td>CONCRETE QUALITY REQUIREMENT S, Drying shrinkage</td>
</tr>
<tr>
<td></td>
<td>Maximum aggregate size ≤ 20 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>maximum 450 µε</td>
<td></td>
</tr>
<tr>
<td></td>
<td>maximum 500 µε</td>
<td></td>
</tr>
<tr>
<td>Consistency</td>
<td>Mechanically placed: 25 mm - 40 mm</td>
<td>CONCRETE QUALITY REQUIREMENT S, Consistency</td>
</tr>
<tr>
<td></td>
<td>Hand placed: 50 mm - 65 mm</td>
<td></td>
</tr>
<tr>
<td>Air content</td>
<td>3% to 7%</td>
<td>CONCRETE QUALITY REQUIREMENT S, Air content</td>
</tr>
<tr>
<td>Thickness</td>
<td>Remove concrete if thickness &gt; 20 mm below documented thickness.</td>
<td>CONCRETE PLACING AND FINISHING, Acceptance criteria for subbase thickness</td>
</tr>
<tr>
<td>Mixing and transport</td>
<td>After addition of cement to the aggregate incorporate concrete into the work within:</td>
<td>PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE, Concrete delivery</td>
</tr>
<tr>
<td></td>
<td>- 90 minutes where transported by truck mixer or agitator.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 60 minutes where transported by non agitating trucks.</td>
<td></td>
</tr>
<tr>
<td>Placing</td>
<td>Protect concrete when the air temperature in the shade is &lt; 10°C or &gt; 30°C.</td>
<td>CONCRETE PLACING AND FINISHING, Ambient conditions</td>
</tr>
<tr>
<td></td>
<td>Protect concrete when the Rate of Evaporation exceeds 0.50 kg/m²/h.</td>
<td>CONCRETE PLACING AND FINISHING, Evaporation and moisture loss</td>
</tr>
<tr>
<td>Alignment and surface tolerances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horizontal alignment</td>
<td>Outer edges not to deviate from plan position by more than ± 25 mm.</td>
<td>CONCRETE PLACING AND FINISHING, Alignment and surface tolerances</td>
</tr>
<tr>
<td>Vertical alignment - subbase</td>
<td>Level on top surface: + 0 mm to - 20 mm deviation from that shown on the drawings.</td>
<td></td>
</tr>
<tr>
<td>Surface finish</td>
<td>Top surface: ± 5 mm deviation from a 3 m straightedge laid in any direction</td>
<td></td>
</tr>
<tr>
<td>Joints</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transverse construction joints</td>
<td>± 10 mm deviation from a 3 m straight edge.</td>
<td>JOINTS, Transverse construction joints</td>
</tr>
<tr>
<td>Longitudinal construction joints</td>
<td>- ± 20 mm deviation from the plan or</td>
<td>JOINTS,</td>
</tr>
</tbody>
</table>
1132 Lean mix concrete subbase

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>nominated position. -± 10 mm deviation from a 3 m straight-edge placed along the joint after allowing for any curvature.</td>
<td>Longitudinal construction joints</td>
</tr>
<tr>
<td>Bond breaker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wax emulsion</td>
<td>Minimum 0.2 l/ m², not earlier than 72 hours before placement of base.</td>
<td>CURING AND DEBONDING, Application of bond breaker</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

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 1132.1 to 1132.5 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:
- The cost of all work, materials and equipment is included in the schedule rate for each Pay item. Concrete and steel reinforcement for subgrade beams is measured and paid to conform to this worksection. Base slab anchors are measured and paid to conform to 1133 Plain and reinforced concrete base.

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>1132.1 Supply and place concrete in subbase</td>
<td>m³ of concrete in place. Volume calculated from width, length and depth shown on drawings or directed by Superintendent.</td>
<td>All costs associated with all documentation and approvals and the supply and placing of concrete subbase in place including construction joints.</td>
</tr>
<tr>
<td>1132.2 Finish and cure subbase</td>
<td>m² of subbase. Area calculated from width, length and depth shown on drawings or directed by Superintendent. Do not include sides of slabs in area calculation.</td>
<td>All costs associated with the finishing and curing of the subbase.</td>
</tr>
<tr>
<td>1132.3 Crack treatment by stress alleviating membrane strip (for asphalt base)</td>
<td>Linear metre of strip. Length is actual length measured on site.</td>
<td>All costs associated with the supply and installation of membrane strip.</td>
</tr>
<tr>
<td>1132.4 Bond breaker</td>
<td>m² of bond breaker. Area based on actual length measured on site and design width shown on drawings. Take no account of tolerances.</td>
<td>All costs associated with the supply and installation of bond breaker.</td>
</tr>
<tr>
<td>1132.5 Subgrade beams</td>
<td>m³ of concrete. Volume determined from width, length, and depth shown on drawings or as directed by</td>
<td>All costs associated with the supply, placing and installation of concrete and reinforcing steel for subgrade beams.</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>Superintendent.</td>
<td></td>
</tr>
</tbody>
</table>
1133 PLAIN AND REINFORCED CONCRETE BASE

1 GENERAL

1.1 RESPONSIBILITIES

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

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of Traffic.
- 1121 Open drains, including kerb and channel (gutter).
- 1132 Lean mix concrete subbase.
- 1172 Subsoil and foundation drains.

1.3 REFERENCED DOCUMENTS

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

Australian standards
AS 1012 Methods of testing concrete
AS 1012.1-1993 Sampling of fresh concrete
AS 1012.3.1-1998 Determination of properties related to the consistency of concrete - Slump test
AS 1012.3.3-1998 Determination of properties related to the consistency of concrete - Vebe test
AS 1012.4.2-1999 Determination of air content of freshly mixed concrete - Measuring reduction in air pressure in chamber above concrete
AS 1012.8.1-2000 Method for making and curing concrete - Compression and indirect tensile test specimens
AS 1012.9-1999 Determination of the compressive strength of concrete specimens
AS 1012.12.2-1998 Determination of mass per unit volume of hardened concrete - Water displacement method
AS 1012.13-1992 Determination of the drying shrinkage of concrete for samples prepared in the field or in the laboratory
AS 1012.14-1991 Method for securing and testing cores from hardened concrete for compressive strength
AS 1141 Methods for sampling and testing aggregates
AS 1141.11.1-2009 Particle size distribution – sieving method
AS 1141.12-1996 Materials finer than 75 micrometre in aggregates (by washing)
AS 1141.14-2007 Particle shape, by proportional calliper
AS 1141.18-1996 Crushed particles in coarse aggregate derived from gravel
AS 1141.22-2008 Wet/dry strength variation
AS 1141.24-1997 Aggregate soundness - Evaluation by exposure to sodium sulfate solution
AS 1160-1996 Bituminous emulsions for the construction and maintenance of pavements
AS 1289 Methods of testing soils for engineering purposes
1133 Plain and reinforced concrete base

AS 1289.4.2.1-1997  Determination of the sulfate content of a natural soil and the sulfate content of the groundwater - Normal method
AS 1379-2007  Specification and supply of concrete
AS 1478  Chemical admixtures for concrete, mortar and grout
AS 1478.1-2000  Admixtures for concrete
AS/NZS 1554  Structural steel welding
AS/NZS 1554.3:2008  Welding of reinforcing steel
AS 2758  Aggregates and rock for engineering purposes
AS 2758.1-1998  Concrete aggregates
AS 3582  Supplementary cementitious materials for use with portland and blended cement
AS 3582.1-1998  Fly ash
AS 3583  Methods of test for supplementary cementitious materials for use with portland cement
AS 3583.13-1991  Determination of chloride ion content
AS 3600-2009  Concrete structures
AS 3799-1998  Liquid membrane—forming curing compounds for concrete
AS 3972-2010  General purpose and blended cements
AS/NZS 4671:2001  Steel reinforcing materials
AS/NZS 4680:2001  Hot-dipped galvanized (zinc) coatings on fabricated ferrous articles
Austroads  Guide to the use of recycled concrete and masonry materials
AGPT04C-2009  Guide to pavement technology part 4C: Materials for concrete road pavements
AGPT04E-2009  Guide to pavement technology part 4E: Recycled materials
AGPT04J-2008  Guide to pavement technology part 4J: Aggregate and source rock
AGPT08-2009  Guide to pavement technology part 8: Pavement construction

Other publications

NSW RMS Test Methods
T 240 – 2012  Road surface texture depth (sand patch)
T 1160 - 2001  Low temperature recovery of preformed polychloroprene elastomeric joint seals for bridge structures
T 1161 - 2001  High temperature recovery of polychloroprene elastomeric joint seals for bridge structures
T 1163 - 2001  Resistance of vulcanised rubber to the absorption of oil
T 1192 – 2001  Adhesion of sealant
T 1193 - 2001  Accelerated Aging of cured sealant
ASTM Standards
C793 - 2010  Standard test method for effects of laboratory accelerated weathering on elastomeric joint sealants
C794 - 2010  Standard test method for adhesion-in-peel of elastomeric joint sealants
D792 - 2008  Standard test methods for density and specific gravity (relative density) of plastics by displacement
D2240 - 2010  Standard test method for rubber property-durometer Hardness
D2628 - 2011  Standard specification for preformed polychloroprene elastomeric joint seals for concrete pavements
D2835 - 2007  Standard specification for lubricant for installation of preformed compression seal in concrete pavements

US Military Specifications
SAE AMS-S - 8802 2011  Sealing compound, temperature resistant, integral fuel tanks and fuel cell cavities, high adhesion
ARRB Group  Specification for Recycled Crushed Glass as an Engineering Material
NSW RMS  QA Roadworks Specification R83 for Jointed Concrete Base

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 m$^3$ 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>DESIGN AND CONTROL OF CONCRETE MIX</td>
<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>
</tr>
<tr>
<td>SITE ESTABLISHMENT</td>
<td>Subbase survey</td>
<td>Work-as-executed survey of the subbase.</td>
<td>2 working days before starting any works</td>
</tr>
<tr>
<td>TRIAL CONCRETE BASE</td>
<td>Construction</td>
<td>Obtain approval for the trial section</td>
<td>5 working days before main works</td>
</tr>
<tr>
<td></td>
<td>Deficient trial section</td>
<td>Review of deficiencies in the trial section</td>
<td>2 working days after construction</td>
</tr>
<tr>
<td></td>
<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>
</tr>
<tr>
<td>SLAB ANCHORS</td>
<td>Excavation</td>
<td>Submit compacted excavated surface</td>
<td>1 working day before concreting</td>
</tr>
<tr>
<td>INSTALATION OF STEEL REINFORCEMENT</td>
<td>Placing and cover requirements</td>
<td>Approval of placement and fastening of reinforcing steel</td>
<td>4 working hours before concrete placement</td>
</tr>
<tr>
<td>PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE</td>
<td>Concrete production and transport</td>
<td>Submit proposed methods and equipment</td>
<td>4 weeks before starting</td>
</tr>
<tr>
<td>PLACING AND FINISHING</td>
<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>
</tr>
<tr>
<td>Clause title / Item</td>
<td>Requirement</td>
<td>Notice of inspection</td>
<td>Release by</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>Surface texture</td>
<td>Submit details of proposed texturing device and method of texturing</td>
<td>Before texturing</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>JOINTS</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>TESTING OF CONCRETE FOR COMRESSIVE STRENGTH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sampling</td>
<td>Inspection of sampling procedure</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Acceptance criteria</td>
<td>Submit test results</td>
<td>Progressive</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Acceptance criteria for cored concrete</td>
<td>Submit test results</td>
<td>Progressive</td>
<td>Principal Certifying Authority</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>Principal Certifying Authority</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>
</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>
</tbody>
</table>
Equipment and methods
Notice of planned start on site
7 working days before starting on site

Consistency
Provide slump check test results
Progressive

Ambient conditions
Provide details of protection methods for cold or hot weather and rain
Progressive

Evaporation and moisture loss
Provide details of precautionary measures to prevent moisture loss when evaporation rate exceeds prescribed limits
Progressive

Paving in general
Construction joint if hand or mechanical paving is disrupted
Progressive

Assessment of base thickness
Survey of base surface, edge alignment and thickness
3 working days after placement

Traffic considerations
Provide traffic management measures
Progressive

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 COMRESSIVE 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 COMPACTION 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

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.

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 (‘ligpol’) 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>

Recycled crushed glass
Requirement: Meet the recommendations of the ARRB Group in Specifications for Recycled Crushed Glass as an Engineering Material and all other technical criteria for fine aggregate.
Blending: Maximum of 30% by mass of the total fine aggregate.

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>
</table>
**Australian Standard Sieve**

<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 (\mu)m</td>
<td>8</td>
</tr>
<tr>
<td>600 (\mu)m to 300 (\mu)m</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 (\mu)m</td>
<td>24–52</td>
<td>± 10</td>
</tr>
<tr>
<td>300 (\mu)m</td>
<td>8–25</td>
<td>± 5</td>
</tr>
<tr>
<td>150 (\mu)m</td>
<td>1–8</td>
<td>± 2</td>
</tr>
<tr>
<td>75 (\mu)m</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.

### 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.

### 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>± 3</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>-</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 C 793</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 surfacing</th>
<th>Base type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wearing surface</td>
<td>No wearing surface</td>
</tr>
<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>
</tr>
<tr>
<td>Water borne hydrocarbon resin or styrene butadiene resin (SBR) conforming with AS 3799 Class Z. *</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Bitumen emulsion grade CRS/170 conforming to AS 1160. *</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>White pigmented wax emulsion Class A Type 2. *</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Debonding treatment bitumen seal with 5-7mm aggregate</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Notes:
Conform to AGPT04C Table 6.1.
* For paving in NSW from November to March, use a Type 2 compound which contains a titanium dioxide reflective pigment. At all other times, use a Type 1-D compound.

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/m³ of concrete</td>
</tr>
<tr>
<td>Minimum flyash content</td>
<td>50 kg/m³ of concrete</td>
</tr>
<tr>
<td>Minimum compressive strength at 28 days</td>
<td>35 MPa</td>
</tr>
</tbody>
</table>
Properties | Quality requirement
--- | ---
Drying shrinkage of nominated mix (AS 1012.13) - at the nominated slump ± 10 mm | < 450 µε after 21 days of air drying average of readings within 5% of the median of the three readings
Consistency (Slump to AS 1012.3.1) | 30 mm - 40 mm for mechanically placed concrete
 | 55 mm - 65 mm for hand placed concrete
Air content (To AS 1012.4.2) | 4% - 7% when discharged from the transport vehicle ready for placement
Minimum relative compaction (To AS 1012.12.2) | 98%

**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 m³ of concrete poured or one day’s production.
- Average: Take the drying shrinkage at the nominated slump ±10 mm as the average of all readings within 30 µε 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.
1133 Plain and reinforced concrete base

- 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:
- 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 with 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 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 dockets: 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.

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 ravelling 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.
Ravelling: Conform to the following:
- The surface of the transverse contraction joint is < 5 mm of vertical or horizontal edge ravelling.
- The length of edge ravelling 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 join 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 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 channel (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 channel (gutter): Construct to conform to Open drains, including kerb and channel (gutter) regardless of method of construction. Provide concrete with strength greater than 35 MPa.
Longitudinal joint with kerb and/or channel (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 tyed 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.
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.
- 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>
<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.

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.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection clause/ subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</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>Aggregates</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>Concrete quality</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>
</tbody>
</table>

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### Activity | Limits/Tolerances | Worksection clause/subclause
--- | --- | ---
Slump | 30 mm - 40 mm for mechanically placed concrete 55 mm - 65 mm for hand placed concrete Vebe time reading – maximum of 3 seconds | CONCRETE QUALITY REQUIREMENTS, Consistency
Air content | 4% to 7% when discharged from the transport vehicle ready for placement. | CONCRETE QUALITY REQUIREMENTS, Air content
Concrete mixing and transport | After addition of cement to the aggregate, concrete to be incorporated into the work within: - 90 minutes where transported by truck mixer or agitator. - 60 minutes where transported by non-agitating trucks. | PRODUCTION, TRANSPORT AND DELIVERY OF CONCRETE, Concrete delivery
Concrete placing | 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. Take precautionary measures if the value of Rate of Evaporation exceeds 0.50 kg/m²/hr, cease work. | PLACING AND FINISHING, Ambient conditions
Alignment and surface | Horizontal alignment of outer edges | PLACING AND FINISHING, Alignment and surface tolerances
Surface level tolerance | +10 mm / –0 mm from design surface levels. | PLACING AND FINISHING, Surface texture
Average surface texture depth | 0.3 mm - 0.65mm. | PLACING AND FINISHING, Surface texture
Joints | General | JOINTS
Transverse contraction joints | May skew 1 in 12 to accommodate construction joints and slab anchors. | JOINTS, Transverse contraction joints
Sawcutting | The surface of the joint not to have more than 5 mm of vertical or horizontal edge ravelling. The length of edge ravelling to be not more than 300 mm in any 1 m length of joint on each edge. | JOINTS, Sawcutting
Temporary sealing | Temporary Sealing—the top of the sealant to be neither higher than nor more than 10 mm below the concrete surface. | JOINTS, Temporary sealing
Permanent sealing | Permanent Sealing—The top of the sealant to be neither less than 5 mm nor more than 7 mm below the surface of the base. | JOINTS, Permanent sealing
Longitudinal tied joints | All parts of any tie bar to be within 50 mm of its designed position. The line of longitudinal tied joints not to deviate from the designed position at any point by more than 10 mm and not deviate from a 3 m straightedge by more than 10 mm having made due allowance for any planned curvature. | JOINTS, Longitudinal tied joints
1133 Plain and reinforced concrete base

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawn-Induced joints</td>
<td>The maximum increase in length of the sealant after installation to be 10% of the original length. The top of the sealant to be neither less than 5 mm nor more than 7 mm below the surface of the base.</td>
<td>JOINTS, Sawn-Induced Joints</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 plane.</td>
<td>JOINTS, Ribbon-Induced Joints</td>
</tr>
<tr>
<td>Slab anchors</td>
<td>Not placed closer than 2.0 m to transverse joints (other than associated transverse expansion joints).</td>
<td>SLAB ANCHORS, General</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

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.
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
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 (channel): Conform to 1121 Open drains, including kerb and channel (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>m³</td>
<td>All costs associated with all documentation and approvals and</td>
</tr>
</tbody>
</table>
## 1133 Plain and reinforced concrete base

<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>the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The depth is the depth documented or as directed by the Superintendent across each section.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Take no account of the allowable tolerances.</td>
</tr>
<tr>
<td>1133.2 Finish, cure and texture base</td>
<td>m²</td>
<td>All costs associated with finishing, curing and texturing the base.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The width and length as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Take no account of the allowable tolerances.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The sides of slabs are not included in the measurement of surface area.</td>
</tr>
<tr>
<td>1133.3 Supply and place wire reinforcing fabric</td>
<td>m²</td>
<td>All costs associated with supplying and placing all wire reinforcing fabric.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The width and length are as shown on the drawings, including odd-shaped and mismatched slabs, or as directed by the Superintendent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Take no account of the allowable tolerances or of any laps.</td>
</tr>
<tr>
<td>1133.4 Supply and install steel bar reinforcement</td>
<td>Tonne of steel reinforcement</td>
<td>All costs associated with supplying and installing reinforcement, except dowels and tie bars.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The mass is to be determined from the unit masses given in AS/NZS 4671 and the actual length of bar measured in place.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Take no account of laps and splices.</td>
</tr>
<tr>
<td>1133.5 Transverse contraction joints</td>
<td>Linear metre</td>
<td>All costs associated with the provision of transverse contraction joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measure the distance along the line of the joint.</td>
</tr>
<tr>
<td>1133.6 Transverse expansion and isolation joints</td>
<td>Linear metre</td>
<td>All costs associated with the provision of transverse expansion and isolation joints.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measure the distance along the line of the joint.</td>
</tr>
<tr>
<td>1133.7 Longitudinal tied joints</td>
<td>Linear metre</td>
<td>All costs associated with the provision of longitudinal tied joints including provision of tie bars.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Measure the distance along the line of the joint.</td>
</tr>
<tr>
<td>1133.8 Longitudinal isolation joints</td>
<td>Linear metre</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></td>
<td></td>
<td>Measure the distance along the line of the joint.</td>
</tr>
<tr>
<td>1133.9 Slab anchors</td>
<td>m³</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></td>
<td></td>
<td>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>
</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>1133.10 Bridge approach</td>
<td>m³</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>
<tr>
<td>slabs</td>
<td></td>
<td>- The width, depth and length are as specified on the drawings, or as directed by the Superintendent.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Take no account of the allowable tolerances.</td>
</tr>
</tbody>
</table>
1 GENERAL

1.1 RESPONSIBILITIES

Objectives

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

Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 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:

AS 1141 Methods for sampling and testing aggregates
AS 1141.3.1-2012 Sampling - aggregates
AS 1141.14-2007 Particle shape, by proportional calliper
AS 1141.22-2008 Wet/dry strength variation
AS 1141.23-2009 Los Angeles value
AS 1141.52-2008 Unconfined cohesion of compacted pavement materials
AS 1289 Methods of testing soils for engineering purposes
AS 1289.3.1.1-2009 Soil classification tests - Determination of the liquid limit of a soil - Four point Casagrande method
AS 1289.3.3.1-2009 Soil classification tests - Calculation of the plasticity index of a soil
AS 1289.3.4.1-2008 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method
AS 1289.3.6.1-2009 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of analysis by sieving
AS 1289.5.1.1-2003 Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using standard compactive effort
AS 1289.5.2.1-2003 Soil compaction and density tests - Determination of the dry density/moisture content relation of a soil using modified compactive effort
AS 1289.5.3.2-2004 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 1289.5.4.1-2007 Soil compaction and density tests - Compaction control test - Dry density ratio, moisture variation and moisture ratio
AS 1289.5.7.1-2006 Soil compaction and density tests - Compaction control test - Hilf density ratio and Hilf moisture variation (rapid method)
AS 1289.5.8.1-2007 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
<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1289.6.1.1-1998</td>
<td>Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen</td>
</tr>
<tr>
<td>AS 5101.4-2008</td>
<td>Methods for preparation and testing of stabilized materials – Unconfined compressive strength of compacted materials</td>
</tr>
</tbody>
</table>

### Other publications

<table>
<thead>
<tr>
<th>Publisher</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSTROADS</td>
<td>Specification for Recycled Crushed Glass as an Engineering Material</td>
</tr>
<tr>
<td>AGPT04A-2008</td>
<td>Guide to pavement technology Part 4A: Granular base and subbase materials</td>
</tr>
<tr>
<td>AGPT04D-2006</td>
<td>Guide to pavement technology Part 4D: Stabilised materials</td>
</tr>
<tr>
<td>RMS</td>
<td>Dry density/moisture relationship of road construction materials (blended in the laboratory with cementitious binders).</td>
</tr>
<tr>
<td>RMS Test Methods</td>
<td>Modified Texas triaxial compression test pavement materials</td>
</tr>
<tr>
<td>RMS</td>
<td>QA Materials Specification 3051 for Granular Base and Subbase Materials for Surfaeced Road Pavements</td>
</tr>
<tr>
<td>RMS</td>
<td>QA Roadworks Specification 73 for Construction of Plant Mixed Heavily Bound Pavement Course</td>
</tr>
<tr>
<td>IPWEA</td>
<td>Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage</td>
</tr>
<tr>
<td>NSW DECCW-2010</td>
<td>Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage – NSW Department of Environment, Climate Change and Water</td>
</tr>
</tbody>
</table>

### 1.4 INTERPRETATIONS

#### 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.
- 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: Material laid on the subgrade (or selected material), below the base, either for the purpose of making up additional pavement thickness, 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.

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 POINTS table and the WITNESS POINTS table.

<table>
<thead>
<tr>
<th>HOLD POINTS table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause title/Item</td>
</tr>
<tr>
<td><strong>PRE-CONSTRUCTION PLANNING</strong></td>
</tr>
<tr>
<td>Activity plan</td>
</tr>
<tr>
<td>Pavement plan</td>
</tr>
<tr>
<td>Design and control of base and subbase materials</td>
</tr>
<tr>
<td>Proposed materials</td>
</tr>
<tr>
<td>Bound or modified materials</td>
</tr>
<tr>
<td>Variations to approved materials</td>
</tr>
<tr>
<td>Inspection, sampling and testing</td>
</tr>
<tr>
<td>Notification</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
</tr>
<tr>
<td>Modified Texas triaxial classification</td>
</tr>
<tr>
<td>Alternative materials</td>
</tr>
<tr>
<td>Lime modified base and subbase materials</td>
</tr>
<tr>
<td>Lime modification</td>
</tr>
<tr>
<td>In-situ lime modification</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
</tr>
<tr>
<td>Spreading</td>
</tr>
<tr>
<td>Underlying layer</td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Clause title/Item</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td><strong>Trimming, compaction and curing</strong></td>
</tr>
<tr>
<td><strong>Plant</strong></td>
</tr>
<tr>
<td><strong>Subsequent layers</strong></td>
</tr>
<tr>
<td><strong>Acceptance of compaction</strong></td>
</tr>
<tr>
<td><strong>Lots for acceptance</strong></td>
</tr>
<tr>
<td><strong>Compaction requirements and acceptance</strong></td>
</tr>
<tr>
<td><strong>Acceptance of dimensions and levels</strong></td>
</tr>
<tr>
<td><strong>General</strong></td>
</tr>
<tr>
<td><strong>Corrective action - rejected unbound layers</strong></td>
</tr>
<tr>
<td><strong>Corrective action - rejected bound layers</strong></td>
</tr>
<tr>
<td><strong>Removal and replacement of rejected courses</strong></td>
</tr>
<tr>
<td><strong>Extent of removal</strong></td>
</tr>
<tr>
<td><strong>Prior to replacement</strong></td>
</tr>
<tr>
<td><strong>Replacement</strong></td>
</tr>
<tr>
<td><strong>Maintenance before completion of wearing surface</strong></td>
</tr>
<tr>
<td><strong>Pavement condition before primerseal</strong></td>
</tr>
<tr>
<td><strong>Opening bound pavement to traffic</strong></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><strong>Bound base and subbase materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>In-situ stabilisation</strong></td>
<td>Give notice of proposal to use mobile plant for in-situ stabilisation at site</td>
<td>2 weeks before activity</td>
</tr>
</tbody>
</table>

**EXECUTION**

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Delivery</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Delivered materials</strong></td>
<td>Give notice for inspection</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>Delivery of modified or bound materials</strong></td>
<td>Give notice of use of vehicles without covers</td>
<td>3 working days before use</td>
</tr>
<tr>
<td>Clause title/Item</td>
<td>Requirement</td>
<td>Notice for inspection</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Delivery dockets bound material</td>
<td>Provide delivery dockets at point of delivery</td>
<td>Progressive</td>
</tr>
<tr>
<td>Stockpiling unbound material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Give notice of proposed alternative locations</td>
<td>2 weeks before stockpiling</td>
</tr>
<tr>
<td>Trimming, compaction and curing</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</td>
</tr>
<tr>
<td>Rework</td>
<td>Give notice for inspection of reworked wetted up layer</td>
<td>Progressive</td>
</tr>
<tr>
<td>Curing of bound materials</td>
<td>Give notice of water curing activities</td>
<td>Progressive</td>
</tr>
<tr>
<td>Acceptance of compaction</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>
</tr>
<tr>
<td>Acceptance of dimensions and levels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layer width</td>
<td>Give notice of completion of layer width</td>
<td>Progressive</td>
</tr>
<tr>
<td>Subbase surface deviation</td>
<td>Give notice of completed subbase surface</td>
<td>Progressive</td>
</tr>
<tr>
<td>Base surface deviation</td>
<td>Give notice of completed base surface</td>
<td>Progressive</td>
</tr>
<tr>
<td>Base adjacent to kerb and gutter</td>
<td>Give notice of completed base surface</td>
<td>Progressive</td>
</tr>
<tr>
<td>Maintenance before completion of wearing surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primerseal</td>
<td>Give notice of alternative procedure</td>
<td>At time of lot acceptance</td>
</tr>
<tr>
<td>Restrictions on movement</td>
<td>Give notice if vehicles are to use unbound pavement before application of primerseal</td>
<td>Progressive</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 with 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
Traffic category: Conform to the categories in the Design traffic table.

**Design traffic table**

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Traffic Classification</th>
<th>Range in Design ESAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Very heavy</td>
<td>$&gt; 10^7$</td>
</tr>
<tr>
<td>B</td>
<td>Heavy</td>
<td>$&lt; 10^7$ but $&gt; 4 \times 10^6$</td>
</tr>
<tr>
<td>C</td>
<td>Medium</td>
<td>$&lt; 4 \times 10^6$ but $&gt; 10^6$</td>
</tr>
<tr>
<td>D</td>
<td>Light</td>
<td>$&lt; 10^6$</td>
</tr>
</tbody>
</table>

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 the base or subbase was used in a separate contract within 12 months of proposed works date.
- 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
Extent: 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

General
Standard: To AGPT04A and ARRB - Sealed local roads manual.
Sampling and testing: To AS 1289 and AS 1141.
Requirement: Provide unbound granular materials, including blends of two or more different materials, which when compacted develop structural stability and are uniform in grading and physical characteristics.

Production: Materials may be produced by crushing plant or naturally occurring granular materials. Methods and properties to conform to this worksection and additional requirements of Austroads AGPT04A.

Material selection: Conform to the Materials selection table.

### Materials selection table

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Unbound base*</th>
<th>Unbound subbase*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DGB20(HD)</td>
<td>DGS20</td>
</tr>
<tr>
<td>B</td>
<td>DGB20(HD) or DGB20</td>
<td>DGS20 or DGS40</td>
</tr>
<tr>
<td>C</td>
<td>DGB20(HD), DGB20 or R-1</td>
<td>DGS20, DGS40 or R-1</td>
</tr>
<tr>
<td>D</td>
<td>DGB20(HD), DGB20, R-1, R-2 or NGB20</td>
<td>DGS20, DGS40, R-1, R-2, NGS20 or NGS40</td>
</tr>
</tbody>
</table>

* or modified in accordance with NSW RMS QA Materials Specification 3051

### Crushed rock and recycled material class

Requirement: Provide crushed rock and recycled material as documented, from the following classes:

- Class 1: Pavement base material (with a minimum plasticity index) for unbound pavements requiring a very high standard of surface preparation for a sprayed sealed or thin asphalt surfacing.
- Class 2: Pavement base material (no minimum plasticity index) for unbound pavements which may not require a very high standard of surface preparation.
- Class 3: Not applicable.
- Class 4: Subbase material for unbound flexible pavements.

**Crushed rock base and subbase**

Designation: Unbound crushed rock materials are designated as follows:

- DGB20(HD): 20 mm nominal sized class 1 crushed rock base.
- DGB20: 20 mm nominal sized class 2 crushed rock base.
- DGS20: 20 mm nominal sized crushed rock subbase.
- DGS40: 40 mm nominal sized crushed rock subbase.

**Recycled base and subbase crushed concrete**

Designation: Recycled crushed concrete materials are designated as follows:

- R-1: 20 mm nominal sized class 1 recycled crushed concrete base and subbase.
- R-2: 20 mm nominal sized class 2 recycled crushed concrete base and subbase.

**Recycled materials meeting RMS 3051 specifications**

**Natural gravel**

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

Base materials: Conform to the Base material properties table.

### Base material properties table

<table>
<thead>
<tr>
<th>Test method</th>
<th>Description</th>
<th>DGB20 (HD)</th>
<th>DGB20</th>
<th>R-1</th>
<th>R-2</th>
<th>NGB20</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1289.3.6.1</td>
<td>Particle size distribution % passing 26.5 mm sieve</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Test method</td>
<td>Description</td>
<td>DGB20 (HD)</td>
<td>DGB20</td>
<td>R-1</td>
<td>R-2</td>
<td>NGB20</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>------------</td>
<td>-------</td>
<td>-----</td>
<td>-----</td>
<td>-------</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>85–100</td>
<td>93–100</td>
</tr>
<tr>
<td></td>
<td>% passing 13.2 mm sieve</td>
<td>78–92</td>
<td>78–92</td>
<td>70–90</td>
<td>70–90</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>% passing 9.5 mm sieve</td>
<td>63–83</td>
<td>63–83</td>
<td>60–80</td>
<td>60–80</td>
<td>71–78</td>
</tr>
<tr>
<td></td>
<td>% passing 4.75 mm sieve</td>
<td>44–64</td>
<td>44–64</td>
<td>40–65</td>
<td>40–65</td>
<td>47–70</td>
</tr>
<tr>
<td></td>
<td>% passing 2.36 mm sieve</td>
<td>33–49</td>
<td>33–49</td>
<td>35–55</td>
<td>35–55</td>
<td>35–56</td>
</tr>
<tr>
<td></td>
<td>% passing 0.425 mm sieve</td>
<td>14–23</td>
<td>14–23</td>
<td>10–30</td>
<td>10–30</td>
<td>14–32</td>
</tr>
<tr>
<td></td>
<td>% passing 0.075 mm sieve</td>
<td>7–14</td>
<td>7–14</td>
<td>5–15</td>
<td>5–15</td>
<td>6–20</td>
</tr>
<tr>
<td></td>
<td>% passing 0.0135 mm sieve</td>
<td>3–7</td>
<td>3–7</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Retained between AS Sieves (% by mass)</td>
<td>19.0mm</td>
<td>7–17</td>
<td>6–18</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>13.2mm</td>
<td>8–16</td>
<td>7–17</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>9.5mm</td>
<td>14–24</td>
<td>13–25</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>4.75mm</td>
<td>8–18</td>
<td>7–19</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>2.36mm</td>
<td>14–28</td>
<td>14–30</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.425mm</td>
<td>6–13</td>
<td>6–13</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.075mm</td>
<td>3–7</td>
<td>3–8</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>0.0135mm</td>
<td>3–7</td>
<td>3–8</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>AS 1289.3.1.1</td>
<td>Liquid limit</td>
<td>max 20</td>
<td>max 20</td>
<td>max 23</td>
<td>max 27</td>
<td>max 25</td>
</tr>
<tr>
<td></td>
<td>Traffic category A</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Traffic Category B, C and D</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>For recycled materials</td>
<td>max 27</td>
<td>max 27</td>
<td>max 27</td>
<td>max 27</td>
<td>max 25</td>
</tr>
<tr>
<td>AS 1289.3.2.1</td>
<td>Plastic limit (if plastic)</td>
<td>max 20</td>
<td>max 20</td>
<td>max 20</td>
<td>max 20</td>
<td>max 20</td>
</tr>
<tr>
<td>AS 1289.3.3.1</td>
<td>Plasticity index:</td>
<td>max 6</td>
<td>max 6</td>
<td>max 5</td>
<td>max 5</td>
<td>max 6</td>
</tr>
<tr>
<td></td>
<td>Traffic category A</td>
<td>min 2</td>
<td>min 2</td>
<td>max 8</td>
<td>max 8</td>
<td>max 6</td>
</tr>
<tr>
<td></td>
<td>Traffic Category B and C</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Traffic Category D</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>% passing 0.425mm sieve x PI</td>
<td>max 120</td>
<td>max 120</td>
<td>max 180</td>
<td>max 180</td>
<td>max 180</td>
</tr>
<tr>
<td>AS 1289.6.7.2</td>
<td>Permeability</td>
<td>max 5 x 10^-8 m/sec</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>RMS T276</td>
<td>Foreign materials in that fraction of recycled material retained on 4.75 mm sieve - % by mass:</td>
<td>max 0</td>
<td>max 0</td>
<td>max 3</td>
<td>max 3</td>
<td>max 5</td>
</tr>
<tr>
<td></td>
<td>Asbestos</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Metal, glass and ceramics</td>
<td>max 0.2</td>
<td>max 0.2</td>
<td>max 0.2</td>
<td>max 0.2</td>
<td>max 0.2</td>
</tr>
<tr>
<td></td>
<td>Plaster, clay lumps and other friable materials</td>
<td>max 0.1</td>
<td>max 0.1</td>
<td>max 0.1</td>
<td>max 0.1</td>
<td>max 0.1</td>
</tr>
<tr>
<td></td>
<td>Rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter</td>
<td>max 0.2</td>
<td>max 0.2</td>
<td>max 0.2</td>
<td>max 0.2</td>
<td>max 0.2</td>
</tr>
</tbody>
</table>
### Test method Description

<table>
<thead>
<tr>
<th>Test method</th>
<th>Description</th>
<th>DGB20 (HD)</th>
<th>DGB20</th>
<th>R-1</th>
<th>R-2</th>
<th>NGB20</th>
</tr>
</thead>
<tbody>
<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 2)</td>
<td>min 1.7 MPa</td>
<td>min 1.7 MPa</td>
<td>min 1.7 MPa</td>
<td>min 1.0 MPa</td>
<td>min 1.7 MPa</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 2)</td>
<td>min 1.7 MPa</td>
<td>min 1.7 MPa</td>
<td>min 1.7 MPa</td>
<td>min 1.0 MPa</td>
<td>min 1.7 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>max 35%</td>
<td></td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Aggregate wet strength&lt;sup&gt;3&lt;/sup&gt;</td>
<td>min 100 kN</td>
<td>min 70 kN</td>
<td>min 70 kN</td>
<td>min 70 kN</td>
<td></td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Wet/dry strength variation&lt;sup&gt;3&lt;/sup&gt; (dry - wet)/dry</td>
<td>max 35%</td>
<td>max 35%</td>
<td>max 35%</td>
<td>max 40%</td>
<td></td>
</tr>
<tr>
<td>AS 1289.6.1.1</td>
<td>4 day soaked CBR (98% modified compaction)</td>
<td>NA</td>
<td>min 60%</td>
<td>min 80%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS 5101.4</td>
<td>Unconfined compressive strength (UCS)</td>
<td>max 1.0 MPa</td>
<td>max 1.0 MPa</td>
<td>max 1.5 MPa</td>
<td>max 1.5 MPa</td>
<td></td>
</tr>
<tr>
<td>RMS T219</td>
<td>Acid Soluble Sulfate Content in Road Construction Materials</td>
<td>max 0.3%</td>
<td>max 0.3%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. As indicated or equivalent RMS Test Method
2. Groupings in table do not align exactly with those in RMS T276
3. 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
Subbase materials: Conform to the Subbase material properties table.

#### Subbase material properties table

<table>
<thead>
<tr>
<th>Test method</th>
<th>Description</th>
<th>DGS20</th>
<th>DGS40</th>
<th>R-1</th>
<th>R-2</th>
<th>NGS20</th>
<th>NGS40</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>
<td></td>
</tr>
<tr>
<td>% passing 53.0 mm sieve</td>
<td>100</td>
<td>95–100</td>
<td>100</td>
<td>95–100</td>
<td>100</td>
<td>95–100</td>
<td>100</td>
</tr>
<tr>
<td>% passing 37.5 mm sieve</td>
<td>75–95</td>
<td>64–90</td>
<td>95–100</td>
<td>70–90</td>
<td>60–80</td>
<td>70–90</td>
<td>60–80</td>
</tr>
<tr>
<td>% passing 26.5 mm sieve</td>
<td>95–100</td>
<td>60–80</td>
<td>95–100</td>
<td>70–90</td>
<td>60–80</td>
<td>70–90</td>
<td>60–80</td>
</tr>
<tr>
<td>% passing 19.0 mm sieve</td>
<td>70–90</td>
<td>60–80</td>
<td>95–100</td>
<td>70–90</td>
<td>60–80</td>
<td>70–90</td>
<td>60–80</td>
</tr>
<tr>
<td>% passing 13.2 mm sieve</td>
<td>60–80</td>
<td>50–70</td>
<td>60–80</td>
<td>50–70</td>
<td>60–80</td>
<td>50–70</td>
<td>60–80</td>
</tr>
<tr>
<td>% passing 9.5 mm sieve</td>
<td>50–70</td>
<td>40–65</td>
<td>50–70</td>
<td>40–65</td>
<td>50–70</td>
<td>40–65</td>
<td>50–70</td>
</tr>
</tbody>
</table>

| AS 1289.3.1.1 | Liquid limit (if material non-plastic)                                      | max 23 | max 23 | max 27 | max 27 | max 35 | max 35 |
| For recycled materials | max 27 | max 27 |

<p>| AS 1289.3.2.1 | Plastic limit (if plastic)                                                  | max 20 | max 20 |
| AS 1289.3.1.1 | Plasticity index: |</p>
<table>
<thead>
<tr>
<th>Test method</th>
<th>Description</th>
<th>DGS20</th>
<th>DGS40</th>
<th>R-1</th>
<th>R-2</th>
<th>NGS20</th>
<th>NGS40</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMS T276</td>
<td>Foreign materials in that fraction of recycled material retained on 4.75 mm sieve - % by mass: Asbestos Metal, glass and ceramics Plaster, clay lumps and other friable materials Rubber, plastic, bitumen, paper, cloth, paint, wood and other vegetable matter</td>
<td>max 0</td>
<td>max 3</td>
<td>max 0.2</td>
<td>max 0.2</td>
<td>max 0.1</td>
<td>max 0.2</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 2)</td>
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<td>min 1.0 MPa</td>
<td>min 1.7 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>
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<td>max 35%</td>
<td>max 35%</td>
<td>max 35%</td>
<td>max 35%</td>
<td>max 35%</td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Aggregate wet strength(^3) Traffic category A and B Traffic Category C and D</td>
<td>min 70 kN</td>
<td>min 70 kN</td>
<td>min 70 kN</td>
<td>min 70 kN</td>
<td>min 70 kN</td>
<td>min 70 kN</td>
</tr>
<tr>
<td>AS 1141.22</td>
<td>Wet/dry strength variation(^3) (dry - wet)/dry Traffic category A and B Traffic Category C and D</td>
<td>max 35%</td>
<td>max 40%</td>
<td>max 35%</td>
<td>max 40%</td>
<td>max 35%</td>
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<td>AS 1289.6.1.1</td>
<td>4 day soaked CBR (98% modified compaction)</td>
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<td>min 60%</td>
<td>min 30%</td>
<td>min 30%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RMS T219</td>
<td>Acid Soluble Sulfate Content in Road Construction Materials</td>
<td>max 0.3%</td>
<td>max 0.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**
1. As indicated or equivalent RMS Test Method
2. Groupings in table do not align exactly with those in RMS T276
3. 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.

**Stockpiled material**
Testing of stockpiled material: To be in accordance with the procedures outlined in the RMS Materials Specification 3051 for DGB20(HD), DGB20, DGS20, DGS40, NGB20 and DGS20/NGS40 unbound materials or the IPWEA Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage for R-1 and R-2 recycled materials.
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 1289.5.1.1.

Modified Texas triaxial classification number requirements table

<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.
Submission: 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

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

Bound base
Base material requirements before stabilisation: To the Base material properties table.
Construction: To RMS QA Specification R73.

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.
Alternative: Give notice of the proposed use of any vehicles not fitted with fabric covers.
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.
Alternative: If the underlying layer becomes non-conforming, due to no fault of the Contractor, the Superintendent may require correction of the underlying layer as a variation to the contract.

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.
Crowned 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 with 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 primerseal. 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 standard compactive effort is ≥ 100%.
Alternative compaction acceptance: For bound layers any zones with relative compaction < 100% (standard compactive effort) but ≥ 95% 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 (standard compactive effort) determined in the laboratory by testing samples to AS 1289.5.2.1.
- Bound layers: The maximum dry density (standard 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.

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 with 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.

Removal
Replacement: If corrective action is unachievable, remove and dispose of material and replace with fresh material to conform with 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.

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 primerseal. Give notice of proposed opening to traffic.
Notification: 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>Clause - subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stockpile sites: Relative compaction</td>
<td>&gt; 95%</td>
<td>Stockpiling unbound materials - Preparation</td>
</tr>
<tr>
<td>Activity</td>
<td>Limits/Tolerances</td>
<td>Clause - subclause</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Stockpile height</td>
<td>&lt; 3 m.</td>
<td>Stockpiling unbound materials - Stockpile maintenance</td>
</tr>
<tr>
<td>Stockpile batter</td>
<td>1.5H:1V max. 3H:1V min.</td>
<td>Stockpiling unbound materials - Stockpile maintenance</td>
</tr>
<tr>
<td>Compacted layer thickness</td>
<td>200 mm max. 100 mm min.</td>
<td>Trimming, compaction and curing - Compaction</td>
</tr>
<tr>
<td>Compaction acceptance: Stockpile batter</td>
<td>≥ 97% (modified compactive effort). For bound pavements, the Superintendent may accept between 92% and 97% provided it represents less than 5% of the area.</td>
<td>Acceptance of compaction - Compaction requirements and acceptance</td>
</tr>
<tr>
<td>Layer width</td>
<td>Zero to + 100 mm of dimensions on drawings. Limited to 50 mm per side.</td>
<td>Acceptance of dimensions and levels - Layer width</td>
</tr>
<tr>
<td>Subbase surface deviation</td>
<td>+ 10 mm, - 25 mm from design level.</td>
<td>Acceptance of dimensions and levels - Subbase surface deviation</td>
</tr>
<tr>
<td>Base surface deviation</td>
<td>+ 10 mm, - 5 mm from design level or ± 5 mm from a 3 m long straightedge placed on surface, immediately prior to sealing.</td>
<td>Acceptance of dimensions and levels - Base surface deviation</td>
</tr>
<tr>
<td>Base adjacent to kerb and gutter</td>
<td>± 5 mm from the level of the lip of adjacent gutter minus design thickness of wearing surface.</td>
<td>Acceptance of dimensions and levels - Base adjacent to kerb and gutter</td>
</tr>
</tbody>
</table>

## 5 MEASUREMENT AND PAYMENT

### 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 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 primerseal: 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>
<tbody>
<tr>
<td>1141.1 Supply, spread and compact subbase course</td>
<td>m²</td>
<td>Take no account of allowable tolerances. All costs associated with all documentation and approvals and:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 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.</td>
</tr>
<tr>
<td>1141.2 Supply, spread and compact base course</td>
<td>m²</td>
<td>Take no account of allowable tolerances. All costs associated with:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The area is be determined by the length and width of work</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>as specified on the drawings or as directed by the Superintendent.</td>
<td>- Supply, spread, compaction, trimming, jointing, and testing of the base course, and curing of bound material.</td>
</tr>
<tr>
<td></td>
<td>- For total relevant thickness shown on the drawings.</td>
<td></td>
</tr>
</tbody>
</table>
1143 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.

Performance
Requirements: [complete/delete]

Design
Designer: Design the composition of the seal materials.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of traffic.

Precedence
General: The locations and required types of sprayed bituminous surfacings, including types of binders and aggregate sizes, as detailed in the Schedule of Job Details. For multiple treatments, the binder and aggregate may be required to be laid in one or more separate applications. Read this section in conjunction with the Schedule of Job Details. If there is conflict between the requirements of this section and Selections, the requirements of the Selections apply.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS 1160-1996 Bituminous Emulsions for Construction and Maintenance of Pavements
AS 1742 Manual of uniform traffic control devices,
AS 1742.3-2009 Traffic control devices for works on roads
AS 2008-1997 Residual bitumen for pavements
AS 2124-1992 General conditions of contract
AS 2157-1997 Cutback Bitumen
AS 2758 Aggregates and rock for engineering purposes
AS 2758.2-2009 Aggregate for sprayed bituminous surfacing
AS 3568-1999 Oils for reducing the viscosity of residual bitumen for pavements

Other publications
AAPA
AAPA-2004 National asphalt specification. 2nd edition
AAPA HS&E Guide No 8 Guide for Environmental Management when Spraying Bituminous Materials
Definitions

- **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 surface.
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.

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 worksection requirements.
  
  Type tests: [complete/delete]
  Type test results: [complete/delete]
  Calculations: [complete/delete]
  Manuals: [complete/delete]
  Prototypes: [complete/delete]
  Samples: [complete/delete]
  Technical data: [complete/delete]
  Warranties: [complete/delete]

Design of sprayed seals
Submit the design of sprayed seals as follows:
- The types of sprayed seal treatment as listed in the schedule of job requirements, or 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 worksection. 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>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Plant</td>
<td>Evidence that plant is registered and insured</td>
<td>2 weeks before using plant</td>
<td>Principal Certifying Authority</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>
</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: To AS 1160.

**Cutback bitumen**

Cutback bitumen: To AS 2157 or may be prepared by the Contractor, in the field, by blending bitumen and cutter 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:

<table>
<thead>
<tr>
<th>Clause title/Item</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Submissions, Design</strong></td>
<td>Submit the sprayed seal design for approval</td>
<td>2 weeks before commencing work</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Aggregate</strong></td>
<td>Source of materials submit for approval</td>
<td>3 weeks before commencing work</td>
</tr>
<tr>
<td><strong>Removal of loose aggregate, Loose aggregate particles</strong></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><strong>Removal of surplus and waste material</strong></td>
<td>Demonstrate that materials are properly disposed</td>
<td>Progressive</td>
</tr>
<tr>
<td><strong>Protection, New work</strong></td>
<td>Demonstrate that line marking and warning signs are in place to protect new work</td>
<td>Progressive</td>
</tr>
</tbody>
</table>
- 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 in the **Schedule of Job Details**.
- Apply only one method of determination of aggregate shape and one combination of hardness and durability.
- If no aggregate details are specified in the **Schedule of Job Details**, select the particular aggregate class, polishing resistance and combination of test methods based on the service conditions and customary test procedures used in the State in which the works are located.

### 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.

<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 store any excess material in a tidy heap or remove, depending on the requirements of the Superintendent. 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

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</td>
<td>No deductions for openings each not exceeding 1 m². All costs associated with priming, primer sealing or sealing.</td>
</tr>
<tr>
<td></td>
<td>- Area</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) @ 15°C</td>
<td>Litres</td>
<td>All costs associated with the preparation of surface and supply and spray primer or primebinder</td>
</tr>
</tbody>
</table>
### Pay items

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1143.4 Supply and spray binder (including adhesion agent where required, and preparation of surface) @ 15°C</td>
<td>Litres</td>
<td>Determine the quantities (in litres) by either:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Measurement of actual volume (at 15°C) of materials used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All costs associated with the 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</td>
<td>Determine the quantities from either:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The target proportion of cutter, oil flux oil, or adhesion agent added to the binder; or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Measurement of actual volume of materials used.</td>
</tr>
<tr>
<td></td>
<td></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</td>
<td>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>
</tr>
<tr>
<td></td>
<td>Volume.</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</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 NON COMPLYING MATERIALS

**Non compliance**

General: If the work or materials supplied is not within the standards defined for supply and application of sprayed bituminous surfacing, the Superintendent may direct:

- That the reduced service life arising from the non compliance is offset by reducing payment for the non complying portion of work or material by the method defined in **Schedule of Job Details**; or,
- With the consent of the Contractor, any other remedial treatment that is expected to provide the required level of service.
## 6 SELECTIONS

### 6.1 SCHEDULE OF JOB DETAILS

<table>
<thead>
<tr>
<th>Item</th>
<th>Road Name</th>
<th>Location</th>
<th>Treatment</th>
<th>Aggregate</th>
<th>Traffic</th>
<th>Estimated rates of application</th>
<th>Other requirements (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type (2)</td>
<td>Desc (3)</td>
<td>Apps (4)</td>
<td>PSV/PAFV min</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>veh/lane/day (7)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>% heavy, % (8)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Binder L/m (9)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Agg. m³/m (10)</td>
<td></td>
</tr>
</tbody>
</table>

1. Map references should nominate directory used
2. Treatment type: Prime only (PO), Primerseal (PS), Prime and seal (P&S), Reseal (R).
3. Treatment description: Strain alleviating membrane (SAM), Strain alleviating membrane interlayer (SAMI), Geotextile reinforced seal (GRS), Surface enrichment (SE)
4. Number of applications: Single/single (S/S), Single/double (S/D), Double/double (D/D)
5. Aggregate Class: A, B or C (AS 2758.2)
6. Aggregate PSV or PAFV: 46 for Class A aggregates unless otherwise specified.
7. Veh/lane/day (v/l/d): Annual Average Daily (24 hr) Traffic / Number of traffic lanes.
8. % Heavy vehicles: Percentage of AADT that are counted as heavy vehicles.
9. Estimated binder application rate for tendering purposes only. Actual rates to be determined after measurement of surface and aggregate properties.
10. Estimated aggregate spread rate for tendering purposes only. Actual rates to be determined after measurement of aggregate ALD.
11. Other requirements may include job specific requirements such as binder type or surface pretreatment.
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 m$^3$ (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 primed or primersealed.
- Loose, poorly bonded, or inadequately compacted materials in the surface of unbound granular base to be primed or primersealed.
- Poorly shaped unbound granular base to be primed 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 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 8)

| Weather conditions (Note 2) | Risk of wash-off in the event of rain within the stipulated periods after spraying (Note 1) |
7.4 PREPARATION OF AGGREGATES

Precoating of aggregates

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 time and rate 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 porus 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 heavier 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>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>
</tr>
<tr>
<td>Dirty</td>
<td>8 to 14</td>
<td>6 to 12</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 A5 Guide to Cutting Practice for PMBs used in SAM and HSS Applications 1, 2

<table>
<thead>
<tr>
<th>Pavement Temperature (°C)</th>
<th>Traffic (veh/lane/day)</th>
<th>S15E</th>
<th>S20E</th>
<th>S35E</th>
<th>S45R</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 to 25</td>
<td>&lt;1000</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
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<tr>
<td></td>
<td>≥1000</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
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<tr>
<td>26 to 32</td>
<td>&lt;1000</td>
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<td>6</td>
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<td>2</td>
</tr>
<tr>
<td></td>
<td>≥1000</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>33 to 38</td>
<td>&lt;1000</td>
<td>4</td>
<td>4-5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>≥1000</td>
<td>2</td>
<td>3-4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>39 to 45</td>
<td>&lt;1000</td>
<td>Min</td>
<td>Min</td>
<td>0-2</td>
<td>4-6</td>
</tr>
<tr>
<td></td>
<td>≥1000</td>
<td>Min</td>
<td>Min</td>
<td>0-2</td>
<td>4-6</td>
</tr>
<tr>
<td>&gt; 45</td>
<td>All</td>
<td>Min</td>
<td>Min</td>
<td>0-2</td>
<td>Min</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Table A6 Binder Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binder</td>
</tr>
<tr>
<td>Bitumen Class 170, Multigrade 600/170</td>
</tr>
<tr>
<td>Bitumen Class 320</td>
</tr>
<tr>
<td>PMB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table A7 Cutback Bitumen Spraying Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS Grade (if applicable)</td>
</tr>
<tr>
<td>AMC 00</td>
</tr>
<tr>
<td>AMC 0</td>
</tr>
<tr>
<td>AMC 1</td>
</tr>
<tr>
<td>AMC 2</td>
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<tr>
<td>AMC 3</td>
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<tr>
<td>AMC 8</td>
</tr>
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<td>AMC 9</td>
</tr>
<tr>
<td>AMC 10</td>
</tr>
</tbody>
</table>

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)

<table>
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Table A9 Volume Conversion Table – Bitumen Emulsion

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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**

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

<table>
<thead>
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<th>Aggregate size (mm)</th>
<th>Traffic Volume (vehicles per lane per day)</th>
<th>Area – m² per roller hour</th>
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<td>7 or smaller</td>
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<td>5000–5500</td>
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<td>10</td>
<td>3000–3500</td>
<td>3500–4000</td>
</tr>
<tr>
<td>14</td>
<td>2500–3000</td>
<td>3000–3500</td>
</tr>
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</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 primerbinder or binder, defer or eliminate the drag brooming. Where drag brooming is eliminated, the Contractor may substitute light hand brooming. Then carry out backrolling 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 ANNEXURE B: NOTES FOR IMPLEMENTATION AND USE OF SPECIFICATION CLAUSES

HEADINGS BELOW RELATE TO THE CLAUSE TITLES USED IN THE MAIN BODY OF THE WORKSECTION

8.1 GENERAL

Applicability
General: The worksection covers the supply of materials and application of sprayed sealing. It is applicable to contract works where the Principal defines the type of treatment required and the Contractor undertakes those activities associated with supply of materials, determination of application rates of binder and aggregate, preparation and spraying of binder, preparation and application of aggregates, rolling of aggregates and clean-up of completed work. Where some of the activities described in this worksection are undertaken by others, responsibility for the relevant items must be clearly defined in the Responsibilities.

This worksection will normally be used as contract documentation in conjunction with a standard General Conditions of Contract such as AS 2124. Contract documentation may also include other works. The terms used in the worksection guidelines are consistent with AS 2124, and include Principal, Superintendent, and Superintendent’s Representative. Where these terms are in conflict with those otherwise used, a general interpretation clause should be inserted in the contract documents.

Schedule of Details: The type of seal, class and nominal size of aggregate and any special binder requirements should be specified in the Schedule of Job Details.

Careful consideration of the Schedule of Job Details is required to ensure that the sprayed seal is of the appropriate type and quality, and provided in a cost effective manner.

Surface preparation: Preparation of surfaces under this worksection is limited to preliminary sweeping and cleaning of surfaces immediately prior to spraying of bituminous material. The scope of work does not include preparation of granular pavements for priming or primersealing, rectification or maintenance of surfacings prior to resealing or the reinstatement of linemarking, raised pavement markers, etc.

Surface preparation is extremely important to the success of sprayed sealing work. Granular pavements should be prepared to a smooth dense surface and dried back to a suitable moisture content (typically 70% of saturation level) to avoid weakening of the granular pavement with trapped moisture. Preliminary work for retreatment of existing surfacings should be carried out well in advance of sealing work (typically six weeks or more). Embedment of aggregate and variable texture of patches is a major cause of blemishes in finished work. Effective application of sprayed seals requires an underlying surface of uniform texture. Corrective treatments may be required for variable surfaces prior to, or in conjunction with sprayed sealing treatments.

Notes on the preparation of pavements are provided in Annexures A and B. Further detailed guidance for the selection of sprayed seal treatments and preparation of surfaces is provided in the Austroads AGPT03 Pavement Surfacings, AGPT04K Seals, AGPT/T190 Specification framework for polymer modified binders and multigrade bitumens (www.austroads.com.au/pavements), AP-T42/06 Guidelines for the Selection and Use of Modified Binders.

Quality systems
The quality requirements of 0161 Quality (Construction) are designed to apply the AUS-SPEC quality system requirements.

The following paragraphs may be substituted if desired:
‘The Contractor shall establish, implement and maintain a Quality System in conformance with this worksection and the requirements of AS/NZS ISO 9001, or a recognised equivalent.’
‘Where required in the contract general clauses, the Contractor shall submit a Quality Plan prior to commencement of any works. The Quality Plan shall take into account the specific requirements for inspection and testing, acceptance/rejection criteria, details of proposed methods and other quality requirements that are contained in the Contract Documents. Appendix B provides Guidelines for process items which may be included in the Quality Plan. No part of the Quality System shall be used to pre-empt or otherwise negate the technical requirements of the contract documents.’

Depending on project type and performance risk, the Principal may undertake an audit of a Contractor’s Quality System and/or Quality Plan as part of prequalification or contract acceptance
procedures. The Principal may also establish additional procedures for surveillance of contract activity and audit/verification of quality of materials and testing.

8.2 MATERIALS

Bituminous materials: The type and/or grade of primer, primerbinder or binder should be specified in Schedule of Job Details. Cutback bitumen for priming and primersealing (and occasionally for sealing) may be specified in terms of the following alternatives:
- Standard grades of cutback bitumen manufactured conforming to AS 2157;
- Cutback bitumen produced in the field by blending Class 170 bitumen with an appropriate type and proportion of cutter oil in a bitumen sprayer, tanker, etc.;
- Proprietary grades of cutback bitumen;
- Standard grades of bitumen emulsion conforming to AS 1160;
- Proprietary grades of bitumen emulsion.

Suppliers of proprietary products should be required to submit their own product specifications for use as a basis for quality control. Depending on their viscosity, standard grades of cutback bitumen are classified as follows:
- Priming classes (AMC00, AMC0, AMC1);
- Primersealing classes (AMC2, AMC3, AMC4);
- Sealing classes (AMC5, AMC6, AMC7).

When used for primersealing, an adhesion agent (usually 1%) should be added to cutback bitumen primerbinders. Adhesion agents may also be added to priming classes, although this is not mentioned in AS 2157.

A guide to the properties of cutback bitumen is provided in Tables B1 and B2. Table B1 provides a guide to the proportions of cutter oil required for field preparation of cutback bitumen. Table B2 provides a guide to practical grades of cutback bitumen primer and primerbinder for various applications based on the viscosity of the binder.

The selection of particular priming and/or primersealing products should be based on field trials or experience. Guidance on the selection of grade and application rate of primer and primerbinder is given in Design of spray seals.

Generally, Class 170 (also Class 320) bitumen is used as the binder for sprayed sealing work with the addition of cutter oil as required, depending on ambient conditions. Modified binders, as well as bitumen emulsion, may also be used. Guidance on the selection of modified binders and other binders for special application is provided in the references outlined in GENERAL, above.

The use of standard grades of cutback bitumen for sealing is uncommon, as sealing binders are generally prepared at the time of application with the proportion of cutter oil adjusted to the ambient conditions at that time.

Table B1 Field preparation of medium curing cutback bitumen

<table>
<thead>
<tr>
<th>Class (AS 2157 designation)</th>
<th>Approx. parts kerosene per 100 parts bitumen (vol. at 15°C)</th>
<th>Equivalent percent of kerosene (vol. at 15°C)</th>
<th>Viscosity at 60°C (Pa.s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precoating and priming classes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMC00</td>
<td>127</td>
<td>56</td>
<td>0.008–0.016</td>
</tr>
<tr>
<td>AMC0</td>
<td>78</td>
<td>44</td>
<td>0.025–0.05</td>
</tr>
<tr>
<td>AMC1</td>
<td>51</td>
<td>34</td>
<td>0.06–0.12</td>
</tr>
<tr>
<td>Primersealing classes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMC2</td>
<td>37</td>
<td>27</td>
<td>0.22–0.44</td>
</tr>
<tr>
<td>AMC3</td>
<td>27</td>
<td>21</td>
<td>0.55–1.10</td>
</tr>
<tr>
<td>AMC4</td>
<td>19</td>
<td>16</td>
<td>2.0–4.0</td>
</tr>
<tr>
<td>Sealing classes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AMC5</td>
<td>12</td>
<td>11</td>
<td>5.5–11.0</td>
</tr>
<tr>
<td>AMC6</td>
<td>7</td>
<td>7</td>
<td>13.0–16.0</td>
</tr>
<tr>
<td>AMC7</td>
<td>3</td>
<td>3</td>
<td>43.0–86.0</td>
</tr>
</tbody>
</table>

Table B2 Grades of primers and primerbinders

<table>
<thead>
<tr>
<th>Grade</th>
<th>Viscosity Range Pa.s @ 60°C</th>
</tr>
</thead>
</table>

© NATSPEC

March 2016
### Grade

<table>
<thead>
<tr>
<th>Grade</th>
<th>Viscosity Range Pa.s @ 60°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primer:</td>
<td></td>
</tr>
<tr>
<td>– Very light</td>
<td>0.010–0.020</td>
</tr>
<tr>
<td>– Light</td>
<td>0.025–0.050</td>
</tr>
<tr>
<td>– Medium</td>
<td>0.050–0.080</td>
</tr>
<tr>
<td>– Heavy</td>
<td>0.080–0.200</td>
</tr>
<tr>
<td>– Very Heavy</td>
<td>0.200–0.400</td>
</tr>
<tr>
<td>Primerbinder:</td>
<td></td>
</tr>
<tr>
<td>– Light / Medium</td>
<td>1.0–3.0</td>
</tr>
<tr>
<td>– Heavy</td>
<td>4.0–7.0</td>
</tr>
</tbody>
</table>

Aggregate: The worksection refers to AS 2758.2, which requires the user to select from a number of options for determination of aggregate hardness and soundness. These options tend to have been developed around the tests considered to provide the most suitable characterisation of the various stone types found in different localities. As a general rule, the standards are applied on a state by state basis as follows:
- Soundness based on Los Angeles Abrasion and Unsound Stone Content: Victoria and Western Australia.
- Soundness based on Ten Percent Fines Value and Wet/Dry Strength Variation: All other States.

AS 2758.2 provides for three classes of aggregate based on the following pavement classifications:
- Class A – premium quality aggregates suitable for freeways, highly trafficked highways or pavements carrying a high volume of heavy vehicles.
- Class B – aggregates suitable for highways or main roads carrying medium traffic volumes, medium to lightly trafficked pavements, general parking areas and similar.
- Class C – aggregates suitable for lightly trafficked roads.

The class of aggregate should be nominated in the Schedule of job details as well as the minimum value of polishing resistance (PSV or PAFV), if required. For general application, a minimum value of 48 should be specified for applications where Class A aggregates are required. No minimum value of PSV or PAFV is usually required for Class B or Class C applications. Surface friction requirements will vary according to the risks associated with operating environment or particular sites, which will also influence design factors associated with surface texture. This may lead to the adoption of higher or lower minimum polishing resistance values for some applications.

### 8.3 DESIGN OF SPRAY SEALS

General: A distinction is made between selection of treatment type and determination of application rates of binder and aggregate for a selected sprayed seal treatment type. The worksection requires the Contractor to determine rates of application using Austroads AP-T68/06 Sprayed Seal Design Method.

In the context of this worksection, the Principal is required to nominate the treatment type as well as provide sufficient information for an accurate assessment of traffic volume for determination of binder application rates.

The traffic volume should be based on actual traffic counts, including the proportion and distribution of heavy vehicles. Where actual traffic counts are not available, or difficult or impractical to measure, a reasonable estimate should be made based on expected usage. Estimates of traffic should only be used for low volume roads. Actual measurement of traffic volumes is particularly important at high traffic volumes or where there is a large proportion of heavy vehicles. Traffic counts should also take into account seasonal variation such as local events, crop harvesting or seasonal tourist traffic. Generally, summer traffic volumes are more critical to design of application rates than winter traffic volumes.

Further critical inputs to determination of application rates using the AP-T68 Method include condition and texture of the existing surface and measurement of aggregate properties. Estimates of existing surface conditions and aggregate average least dimension (ALD) may be made by the Principal as a basis for determining nominal rates of application for tendering purposes. Before commencing spraying operations, nominal rates of application must be checked by the Contractor, and adjusted as necessary, based on actual measurement of surface texture.
and aggregate grading, shape and ALD determined from testing of materials sampled from stockpiles of the aggregates to be used on the work. Variations to texture within the job and use of corrective treatments must be noted. Aggregate properties must be determined on current materials and not be based on assigned values or estimates from previous work.

Geotextile Reinforced Seals: Binder application rates for geotextile reinforced seals should be determined in conformance with standard procedures (AP-T68 Method). The binder retention allowance will depend on the grade or thickness (mass) of the fabric and may vary between different manufacturers. Typical allowances are shown in Table B3, however, guidance on the selection of a binder retention allowance should be sought from the geotextile supplier or may be determined using test method ASTM D6140.

A minimum fabric mass of 130 g/m² is used for general sealing applications. On soft substrates, such as initial treatment on low quality granular base materials, heavier grades of fabric (175 g/m² to 200 g/m²) should be used to minimise the potential for aggregate to puncture the fabric, particularly when using aggregates of 14 mm nominal size, or greater. Austroads AP-T37/05 Geotextile Reinforced Seals should be consulted for guidance on field procedures.

Priming: A guide to selection of grade of cutback bitumen primer and primer application rates is shown in the Table B4.

Standard grades of bitumen emulsion are generally not suitable for priming but proprietary grades have been developed that should be used in conformance with manufacturer’s guidelines.

Primersealing: A guide to the selection of type and grade of primerbinder is shown in Table B5.

The aggregate size will depend on traffic and climatic conditions. For less than 1200 vehicles/lane/day, 5 mm or 7 mm size aggregate is appropriate, and for higher traffic situations use 7 mm or 10 mm size aggregate. However, if the conditions are either very hot or wet and the traffic is in excess of 600 v/l/d, a 10 mm size aggregate may be used. The use of 10 mm aggregate may, however, result in a coarse texture that requires extra consideration in the placing of the subsequent seal.

There are no formal design procedures for primerbinder application rates for primerseals. Table B6 offers some practical guidelines. The basic primerbinder application rates shown may need to be adjusted in line with allowances for absorption, existing surface condition and embedment.

Austroads Commentary to AG:PT/T252 – Penetration of road bases by bituminous primers or primerbinders, may also provide assistance in estimating pavement absorption (www.austroads.com.au/pavements).

The primerbinder application rates shown refer to the total volumes of the mixtures (i.e., including cutter oils and/or water content) expressed at 15°C.

Aggregate spread rates should be:
- For 5 mm and 7 mm aggregates: 130 m²/m³ - 150 m²/m³
- For 10 mm aggregates: 110 m²/m³ - 130 m²/m³.

### Table B3 Typical Geotextile Retention Allowances

<table>
<thead>
<tr>
<th>Geotextile grade</th>
<th>Retention allowance (L/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>130 - 140g/m²</td>
<td>0.9 to 1.0</td>
</tr>
<tr>
<td>175 - 200g/m²</td>
<td>1.1 to 1.3</td>
</tr>
</tbody>
</table>

### Table B4 Guide to grade and rates of application of primer

<table>
<thead>
<tr>
<th>Pavement</th>
<th>Primer Grade</th>
<th>Rate of Application L/m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightly bonded</td>
<td>Light</td>
<td>0.6–1.1</td>
</tr>
<tr>
<td>Medium porosity</td>
<td>Medium</td>
<td>0.8–1.1</td>
</tr>
<tr>
<td>Porous</td>
<td>Heavy to Very heavy</td>
<td>0.9–1.3</td>
</tr>
<tr>
<td>Limestone</td>
<td>Heavy to Very heavy</td>
<td>2 applications:</td>
</tr>
<tr>
<td></td>
<td>1st @ 0.7–0.9</td>
<td>2nd @ 0.5–0.7</td>
</tr>
<tr>
<td>Sandstone</td>
<td>Heavy to Very heavy</td>
<td>2 applications:</td>
</tr>
</tbody>
</table>
|                   | 1st @ 0.7–0.9         | 2nd @ 0.5–0.7
### Table B5 Selection of type and grade of primerbinder

<table>
<thead>
<tr>
<th>Primerbinder</th>
<th>Recommended use</th>
</tr>
</thead>
</table>
| Light-medium grade of cutback bitumen | - Cool and/or damp conditions.  
- Tightly bonded or medium porosity type pavements. |
| Heavy grade of cutback bitumen | - Warmer and/or dry conditions  
- Porous type pavements. |
| Bitumen Emulsion (60% and 67% bitumen content) | - All year, but more suited to cool and/or damp conditions  
- Porous type pavements  
- When final surfacing is to be applied immediately or within 3 months. |

### Table B6 Basic primerbinder application rates

<table>
<thead>
<tr>
<th>Traffic (v/l/d)</th>
<th>Aggregate Size</th>
<th>Total Primerbinder Application Rate (L/m² @ 15°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Bitumen Emulsion 60%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cutback Bitumen 60%</td>
</tr>
<tr>
<td>≤ 150</td>
<td>7 or 5 10</td>
<td>1.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.4</td>
</tr>
<tr>
<td>151–1200</td>
<td>7 or 5 10</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.3</td>
</tr>
<tr>
<td>&gt; 1200</td>
<td>7 or 5 10</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.2</td>
</tr>
</tbody>
</table>

### 8.4 APPLICATION OF SPRAYED SEALING

The worksection does not include detailed procedures for carrying out sprayed sealing work. A general guide to good practice is provided in the Appendix to the worksection. The detailed provisions of are not mandatory but it is expected that the Contractor will adhere to the principles described and incorporate relevant procedures in his own Quality Plan. A guide to evaluating and auditing of quality plans and surveillance of contract activity is provided in a separate document prepared jointly by Austroads and AAPA (AP-T40/05).

### 8.5 REMOVAL OF LOOSE AGGREGATE

Removal of loose aggregate can generally commence when initial aggregate adhesion and interlock has been completed by rolling and traffic, the binder has hardened to a state where no more aggregate can be pressed into it, and the seal is less prone to damage by sweeping. Factors that influence the timing of aggregate removal include:
- Traffic volume/road class.
- Type of binder.
- Aggregate size.
- Ambient temperature/pavement temperature.

High traffic volumes will rapidly fix aggregates into the binder so that removal of surplus stones may commence within a few hours of spreading. High traffic volumes are also often associated with roads in urban areas and other situations where it is important to minimise risks associated with loose aggregate, so that removal is often undertaken within about 12 hours of spreading. On lighter trafficked roads, a period of up to 48 hours may be allowed to elapse before completing the removal of excess aggregate, provided the safety of the travelling public is appropriately considered.
Polymer modified binders develop cohesion more rapidly, particularly at higher ambient temperatures, so that aggregate removal can often be undertaken on the same day.

Emulsion binders develop cohesion more slowly. Up to 48 hours curing may be necessary, in some circumstances, before sweeping can be undertaken without a high risk of damage to the seal.

Extra care is required at higher temperatures, particularly in sunny conditions and air temperatures of 30°C or more. In such circumstances it is preferable to undertake aggregate removal at night or early morning, when air and pavement temperatures are lower.

In urban areas, the use of a vacuum broom or suction sweeper to uplift and remove aggregate from site as well as removal from kerb and channel, adjoining paved areas, etc. should be specified. In rural areas, where loose aggregate can be safely swept onto unpaved verges, uplifting and removal of aggregate from site is generally not necessary.

8.6 REMOVAL OF SURPLUS AND WASTE MATERIAL

Special requirements for disposal of surplus aggregate at stockpile sites should be specified in additional clauses or included in the schedule of job details.

8.7 PROTECTION AND CARE OF NEW WORK

Generally the Contractor is responsible for protecting the new work and correction of any defects occurring within the defects liability period with the exception of damage caused by accident and other events outside the control of the Contractor.

8.8 SAMPLING AND TESTING

The worksection requires the Contractor to prepare a schedule for the nominated items. The Principal may, however, choose to specify test methods and minimum frequency of sampling and testing.

8.9 MEASUREMENT AND PAYMENT

The worksection provides for two alternatives, measurement by area only, or measurement of actual quantities used.

Measurement and payment by area may be used for straightforward works where conditions are readily identifiable at the time of tender.

Measurement by quantity of material supplied allows for variation in the design rates of application of binder and aggregate and compensation for actual amounts of cutter oil based on the conditions at the time of spraying. In such cases, the schedule may nominate provisional rates of application or quantities for tendering purposes, but incorporate schedule items for actual quantities or variations to rates of application. This type of payment schedule is particularly applicable to contracts incorporating a range of types or location of works.

Schedule items may also be included for other special items such as geotextiles, and for additional works such as reinstatement of raised pavement markers and linemarking, if required.

A typical schedule of rates is shown in Table B7.

Table B7 Typical Schedule of Rates

<table>
<thead>
<tr>
<th>Activity</th>
<th>Unit</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control traffic to worksite</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>Sweep surface prior to seal:</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>- Gravel pavements</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>- Sealed pavements</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>Supply and spray binder @ 15°C</td>
<td>Litre</td>
<td></td>
</tr>
<tr>
<td>Supply, incorporate and spray cutter oil @ 15°C</td>
<td>Litre</td>
<td></td>
</tr>
<tr>
<td>Supply, incorporate &amp; spray Adhesion agent @ 15°C</td>
<td>Litre</td>
<td></td>
</tr>
<tr>
<td>Remove existing raised pavement markers</td>
<td>each</td>
<td></td>
</tr>
<tr>
<td>Protect existing raised pavement markers</td>
<td>each</td>
<td></td>
</tr>
<tr>
<td>Supply and install temporary raised pavement markers</td>
<td>each</td>
<td></td>
</tr>
<tr>
<td>Supply, load, haul and spread precoated aggregate</td>
<td>m³</td>
<td></td>
</tr>
<tr>
<td>Roll and incorporate aggregate</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>Post-sweep of seal including stone counts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Unit</td>
<td>Rate</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>------</td>
<td>---------------</td>
</tr>
<tr>
<td>- With rotary broom</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>- With suction broom as stipulated</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>Supply and place geotextile</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>Load, haul and spread additional where closest available stockpile greater than 5 km from jobsite</td>
<td>m³/km &gt; 5 km</td>
<td></td>
</tr>
</tbody>
</table>

### 8.10 SELECTIONS

The following actions should be taken in the preparation of the **Schedule of job details** and schedule of rates:

- Define scope of work. In addition to a description of location, the limits of work should also be clearly marked on the road pavement.
- Define type of sprayed seal treatment(s).
- Define aggregate Class and minimum PSV or PAFV, if required.
- Define binder type or grade.
- Include details of traffic for design purposes.
- Include any special design requirements, if applicable.
- Prepare and insert special clauses for submission of sprayed seal design details in advance of sprayed sealing work, if applicable.
- Prepare price schedule based on the scope of work and method of measurement and payment.
- Prepare a schedule for sites available for the stockpiling of aggregates, if applicable.
- Prepare and insert special clauses for test methods and frequency of testing, if applicable.
- Prepare and insert special clauses for payment for non complying materials, if applicable.
- Prepare and insert special clauses for removal of loose aggregate by suction broom, if applicable.
- Prepare and insert special clauses for reinstatement of line marking, if applicable.
- Prepare and insert clauses for any other special job requirements, if applicable.
144 ASPHALTIC CONCRETE (ROADWAYS)

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.

Performance
Requirements: [complete/delete]

Design
Designer: Design the asphalt mixes.
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS 1141 Methods for sampling and testing aggregates
AS 1141.17-1995 Voids in dry compacted filler
AS 1141.25.3-2003 Degradation factor - Fine aggregate
AS 1160-1996 Bituminous emulsions for the construction and maintenance of pavements
AS 1672 Limes and Limestones
AS 1672.1-1997 Limes for Building
AS 2008-1997 Residual bitumen for pavements
AS 2124-1992 General conditions of contract
AS 2150-2005 Hot mix asphalt - a guide to good practice
AS 2758 Aggregates and rock for engineering purposes
AS 2758.5-2009 Coarse asphalt aggregates
AS 3582 Supplementary cementitious materials for use with portland cement,
AS 3582.1-1998 Fly Ash
AS 3940-1990 Quality control - Guide to the use of control chart methods including Cusum techniques
AS 3942-1993 Quality control - Variables charts - Guide
AS 3972-2010 General purpose and Blended Cements

Other publications
RMS
NSW RMS Test Methods

AAPA
AAPA 2004 National asphalt specification 2004
AAPA Advisory note 7-2003 Guide to the selection, heating and storage of binders for sprayed sealing and hot mixed asphalt.
AAPA IG-3-2004 Asphalt plant process control guide (Implementation Guide series)

AUSTRoads
AP-T41-2006 Specification framework for polymer modified binders and multigrade bitumens

AGPT03-2009 Guide to Pavement Technology Part 3 – Pavement surfacings
AGPT04B-2007 Guide to Pavement Technology Part 4B - Asphalt
AGPT04E-2009 Guide to Pavement Technology Part 4E – Recycled materials
AGPT04F-2008 Guide to Pavement Technology Part 4F - Bituminous binders
AGPT04J-2008 Guide to Pavement Technology Part 4J - Aggregate and source rock
AGPT04K-2009 Guide to Pavement Technology Part 4K – Seals
ARRB Group Specification for Recycled Crushed Glass as an Engineering Material

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.
- OGA: Open graded asphalt.
- RAP: Reclaimed asphalt pavement.
- SMA: Stone mastic asphalt.
- UTOGA: Ultra thin open graded asphalt.

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
- Traffic category (Light, Medium, Heavy and Very Heavy). Where relevant, the same traffic categories to apply to other mix types.
The particular mixes to be used to be nominated in the Schedule of job details. Dense graded hot mix asphalt is also known as asphaltic concrete and designated by the abbreviation ‘AC’.

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.

Calculations: [complete/delete]

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.

Manuals: [complete/delete]

Materials
General: Refer listed materials for submissions.

Prototypes: [complete/delete]

Samples: [complete/delete]

Technical data: [complete/delete]

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

Warranties
General: [complete/delete]

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.

<table>
<thead>
<tr>
<th>HOLD POINTS table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause/subclause</td>
</tr>
<tr>
<td>Submissions – Planning requirements</td>
</tr>
<tr>
<td>Aggregate</td>
</tr>
<tr>
<td>Source</td>
</tr>
<tr>
<td>Mix design</td>
</tr>
<tr>
<td>Clause/subclause</td>
</tr>
<tr>
<td>----------------------------------------</td>
</tr>
<tr>
<td>Design of asphalt mixes incorporating RAP</td>
</tr>
<tr>
<td>Approval of Job Mix - General</td>
</tr>
<tr>
<td>Approval of Job Mix - Approval to use previously designed mix</td>
</tr>
</tbody>
</table>

**Sampling and testing**

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of sampling and testing</td>
<td>Frequency varied to correct non-conformance</td>
<td>24 hours after non-conformance identified</td>
<td>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Delivery – work records</td>
<td>Submission for counter signing</td>
<td>Each day for daily completion</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>

**Placing**

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
<th>Release by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spreading</td>
<td>Procedure proposed for low temperature spreading</td>
<td>24 hours before proposed spreading</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Joints</td>
<td>Submit plan of joints location for approval</td>
<td>7 days before commencing</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>

**WITNESS POINTS table**

<table>
<thead>
<tr>
<th>Clause/subclause</th>
<th>Requirement</th>
<th>Notice for inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submissions – Planning requirements</td>
<td>Superintendent to assess faulty plant</td>
<td>Progressive</td>
</tr>
<tr>
<td>Aggregate – General</td>
<td>Source subject to inspection and approval of Superintendent</td>
<td>3 weeks before importing aggregate</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>
</tr>
<tr>
<td>Manufacture and storage – Storage of mixed asphalt</td>
<td>Inspection of storage procedures by Superintendent</td>
<td>Progressive</td>
</tr>
<tr>
<td>Placing</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>
</tr>
<tr>
<td>Tack coating</td>
<td>Direction by Superintendent to omit tack coat</td>
<td>Progressive</td>
</tr>
<tr>
<td>Finished pavement properties</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>Provide notice of procedures and results to Superintendent</td>
<td>Progressive</td>
</tr>
<tr>
<td>Measurement by mass</td>
<td>Method of weighing subject to Superintendent approval</td>
<td>3 days before measurement</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.
- Fine aggregate consisting of recycled crushed glass meeting the ARRB Specification for Recycled Crushed Glass as an Engineering Material and all other requirements outlined in this specification. The maximum blend of recycled crushed glass to the total fine aggregate is 30% by mass.

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>
</tr>
</thead>
<tbody>
<tr>
<td>Los Angeles Abrasion Loss (% maximum)</td>
<td>Heavy/Very Heavy Traffic Mix Types</td>
</tr>
<tr>
<td></td>
<td>Rock type</td>
</tr>
<tr>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Unsound stone content (%)</td>
<td>3 maximum</td>
</tr>
<tr>
<td>Marginal and unsound stone content (%)</td>
<td>8 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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy/Very Heavy Traffic Mix Types</td>
</tr>
<tr>
<td>Ten Percent Fines Value (Wet) (kN)</td>
<td>150 minimum</td>
</tr>
<tr>
<td>Wet/Dry Strength Variation (%)</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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Heavy/Very Heavy Traffic Mix Types</td>
</tr>
<tr>
<td>Flakiness Index (% maximum)</td>
<td>25</td>
</tr>
<tr>
<td>Weak particles (% maximum)</td>
<td>1</td>
</tr>
<tr>
<td>Water absorption (% maximum)</td>
<td>2</td>
</tr>
<tr>
<td>Polished Stone Value or Polished Aggregate Friction Value of wearing course asphalt</td>
<td>48 minimum</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 Limestones – 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>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 conformance 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>37.5</td>
<td>Percentage passing sieve size (by mass)</td>
<td>100</td>
<td>90–100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.5</td>
<td>100</td>
<td>90–100</td>
<td>72–87</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
<td>90–100</td>
<td>73–88</td>
<td>58–76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2</td>
<td>100</td>
<td>90–100</td>
<td>71–86</td>
<td>58–76</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>38–58</td>
<td></td>
</tr>
<tr>
<td>6.7</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>3–6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Binder Content (% by mass)</td>
<td>4.5–6.5</td>
<td>4.0–6.0</td>
<td>3.8–5.81</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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AC7</td>
</tr>
<tr>
<td></td>
<td>AC10</td>
</tr>
<tr>
<td></td>
<td>AC14</td>
</tr>
</tbody>
</table>
### Table 2.9 Open Graded Asphalt and Ultra Thin Asphalt

<table>
<thead>
<tr>
<th>Sieve Size AS (mm)</th>
<th>Mix designation</th>
<th>Percentage passing sieve size (by mass)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OGA10</td>
<td>OGA14</td>
</tr>
<tr>
<td>19.0</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>13.2</td>
<td>100</td>
<td>85–100</td>
</tr>
<tr>
<td>9.5</td>
<td>85–100</td>
<td>45–70</td>
</tr>
<tr>
<td>6.7</td>
<td>35–70</td>
<td>25–45</td>
</tr>
<tr>
<td>4.75</td>
<td>20–45</td>
<td>10–25</td>
</tr>
<tr>
<td>2.36</td>
<td>10–20</td>
<td>7–15</td>
</tr>
<tr>
<td>1.18</td>
<td>6–14</td>
<td>6–12</td>
</tr>
<tr>
<td>0.600</td>
<td>5–10</td>
<td>5–10</td>
</tr>
<tr>
<td>0.300</td>
<td>4–8</td>
<td>4–8</td>
</tr>
<tr>
<td>0.150</td>
<td>3–7</td>
<td>3–7</td>
</tr>
<tr>
<td>0.075</td>
<td>2–5</td>
<td>2–5</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Binder Content (% by mass)</td>
<td>5.0–7.0</td>
<td>4.5–6.5</td>
</tr>
</tbody>
</table>
### Table 2.10 Stone Mastic Asphalt

<table>
<thead>
<tr>
<th>Sieve Size AS (mm)</th>
<th>Mix designation</th>
<th>SMA7</th>
<th>SMA10</th>
<th>SMA14</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>30–55</td>
<td></td>
</tr>
<tr>
<td>9.5</td>
<td>100</td>
<td>90–100</td>
<td>30–55</td>
<td></td>
</tr>
<tr>
<td>6.7</td>
<td>85–100</td>
<td>30–55</td>
<td>20–35</td>
<td></td>
</tr>
<tr>
<td>4.75</td>
<td>30–62</td>
<td>20–40</td>
<td>18–30</td>
<td></td>
</tr>
<tr>
<td>2.36</td>
<td>20–35</td>
<td>15–28</td>
<td>15–28</td>
<td></td>
</tr>
<tr>
<td>1.18</td>
<td>16–28</td>
<td>13–24</td>
<td>13–24</td>
<td></td>
</tr>
<tr>
<td>0.600</td>
<td>14–24</td>
<td>12–21</td>
<td>12–21</td>
<td></td>
</tr>
<tr>
<td>0.300</td>
<td>12–20</td>
<td>10–18</td>
<td>10–18</td>
<td></td>
</tr>
<tr>
<td>0.150</td>
<td>10–16</td>
<td>9–14</td>
<td>9–14</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>8–12</td>
<td>8–12</td>
<td>8–12</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>6.0–7.3</td>
<td>6.0–7.0</td>
<td>5.8–6.8</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2.11 Fine Gap Graded Asphalt

<table>
<thead>
<tr>
<th>Sieve Size AS (mm)</th>
<th>Mix designation</th>
<th>FGG7</th>
<th>FGG10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage passing sieve size (by mass)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.2</td>
<td></td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>9.5</td>
<td>100</td>
<td>85–100</td>
<td></td>
</tr>
<tr>
<td>6.7</td>
<td>85–100</td>
<td>60–86</td>
<td></td>
</tr>
<tr>
<td>4.75</td>
<td>65–85</td>
<td>55–74</td>
<td></td>
</tr>
<tr>
<td>2.36</td>
<td>55–72</td>
<td>50–70</td>
<td></td>
</tr>
<tr>
<td>1.18</td>
<td>45–65</td>
<td>45–65</td>
<td></td>
</tr>
<tr>
<td>0.600</td>
<td>30–60</td>
<td>30–60</td>
<td></td>
</tr>
<tr>
<td>0.300</td>
<td>18–40</td>
<td>18–40</td>
<td></td>
</tr>
<tr>
<td>0.150</td>
<td>8–18</td>
<td>8–18</td>
<td></td>
</tr>
<tr>
<td>0.075</td>
<td>6–12</td>
<td>5–11</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Binder Content (% by mass)</td>
<td>6.0–7.0</td>
<td>6.0–7.0</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.
Open graded asphalt
Open graded asphalt mixes: Conform to the following:
- Comply with the volumetric (Level 1) design criteria listed in Table 2.15. and comply with the Asphalt Particle Loss values listed in Table 2.16.
- OGA and UTOGA to have a maximum binder drain-off test value, at 170°C, of 0.3% by mass except that a lower value of test temperature may be applied where that temperature will not be exceeded during manufacture and transport of the asphalt.

Stone mastic asphalt
Stone mastic asphalt mixes: Conform to the following:
- Comply with the volumetric design criteria listed in Table 2.17.
- Contain a minimum of 0.3% by mass of cellulose or acrylic fibre or a minimum of 0.5% by mass of mineral fibre.
- Have a maximum binder drain-off test value, at 170°C, of 0.3% by mass.
- Use A15E polymer modified binder to eliminate the risk of flushing/bleeding in wheel paths.

Fine gap graded asphalt
Fine gap graded asphalt mixes: Only to be used where the Design Traffic Loading is less than 4 x 10^5 ESAs. The mix designation is to be FGG10 and it must comply with the design criteria given in Table 2.18.

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

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Traffic category</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>Light</td>
<td>Light Wearing and base</td>
<td>50</td>
<td>3.0 – 7.0</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Medium Wearing and base</td>
<td>80</td>
<td>3.0 – 7.0</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium High fatigue base</td>
<td>80</td>
<td>2.0 – 4.0</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>Heavy Wearing and base</td>
<td>120</td>
<td>3.0 – 7.0</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy High fatigue base</td>
<td>80</td>
<td>2.0 – 4.0</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Very Heavy</td>
<td>Very Heavy Wearing and base</td>
<td>120</td>
<td>3.0 – 7.0</td>
<td>2.0</td>
<td></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>Traffic category</th>
<th>Application</th>
<th>Air voids (%)</th>
<th>Stability – min (kN)</th>
<th>Flow (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>Light Wearing and base</td>
<td>3.0 – 7.0</td>
<td>5.5</td>
<td>2–4</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>Medium Wearing and base</td>
<td>4.0 – 7.0</td>
<td>6.5</td>
<td>2–4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Medium High fatigue base</td>
<td>2.0 – 4.0</td>
<td>6.5</td>
<td>2–4</td>
<td></td>
</tr>
<tr>
<td>Heavy</td>
<td>Heavy Wearing and base</td>
<td>3.0 – 7.0</td>
<td>6.5</td>
<td>2–4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Heavy High fatigue base</td>
<td>2.0 – 4.0</td>
<td>6.5</td>
<td>2–4</td>
<td></td>
</tr>
<tr>
<td>Very Heavy</td>
<td>Very Heavy Wearing and base</td>
<td>3.0 – 7.0</td>
<td>7.0</td>
<td>2–4</td>
<td></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>Gyratory compaction</th>
<th>Marshall compaction (50 blow')</th>
<th>Heavy/Very Heavy Traffic Wearing Course Mixes</th>
<th>Other mix types</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>17</td>
<td>–</td>
<td>17</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>16</td>
<td>17</td>
<td>16</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>15</td>
<td>16</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>14</td>
<td>–</td>
<td>14</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>13</td>
<td>–</td>
<td>13</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>12</td>
<td>–</td>
<td>12</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.

Table 2.15 Level 1 Design Requirements for Open Graded Asphalt Mixes

<table>
<thead>
<tr>
<th>Mix type/Traffic category</th>
<th>Laboratory compaction</th>
<th>Air voids (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gyratory (cycles)</td>
<td>Marshall (blows)</td>
</tr>
<tr>
<td>OGA Light/Medium</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>OGA Heavy/Very Heavy</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>UTOGA</td>
<td>No specified requirement</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.16 Asphalt Particle Loss

<table>
<thead>
<tr>
<th>Mix type/Traffic category</th>
<th>Asphalt particle loss – maximum (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unconditioned</td>
</tr>
<tr>
<td>OGA Light/Medium</td>
<td>25</td>
</tr>
<tr>
<td>OGA Heavy/Very Heavy</td>
<td>20</td>
</tr>
<tr>
<td>UTOGA</td>
<td>No specified requirement</td>
</tr>
</tbody>
</table>

Table 2.17 Level 1 Design Requirements for Stone Mastic Asphalt Mixes

<table>
<thead>
<tr>
<th>Mix type</th>
<th>Size (mm)</th>
<th>Traffic category</th>
<th>Laboratory compaction</th>
<th>Air voids (%)</th>
<th>VMA – minimum (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7</td>
<td>Light/Medium</td>
<td>Gyratory (cycles)</td>
<td>Marshall (blows)</td>
<td>3.0 – 6.0</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Light/Medium</td>
<td>80</td>
<td>50</td>
<td>3.0 – 6.0</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Heavy/Very Heavy</td>
<td>120</td>
<td>75</td>
<td>3.0 – 6.0</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>Heavy/Very Heavy</td>
<td>120</td>
<td>75</td>
<td>3.0 – 6.0</td>
</tr>
</tbody>
</table>

Table 2.18 Design Requirements for Fine Gap Graded Asphalt Mixes

<table>
<thead>
<tr>
<th>Traffic category</th>
<th>Laboratory compaction</th>
<th>Air voids (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gyratory (cycles)</td>
<td>Marshall (blows)</td>
</tr>
<tr>
<td>Light</td>
<td>50</td>
<td>35</td>
</tr>
</tbody>
</table>

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 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>4</td>
<td>Test results in accordance with the design requirements specified in Mix properties.</td>
</tr>
<tr>
<td>5</td>
<td>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</td>
</tr>
</tbody>
</table>

**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>
</tbody>
</table>
Material | Sample quantity
---|---
RAP (if used) | 50 kg
Added Mineral Filler | 5 kg
Binder | 8 litres
Additives | As appropriate

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>
<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>
<tr>
<td>Aggregates before mixing with binder</td>
<td>200</td>
</tr>
<tr>
<td>Asphalt at discharge from asphalt plant</td>
<td>175¹</td>
</tr>
</tbody>
</table>

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 3.1.2 Production Tolerances

<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.
- Open graded asphalt and stone mastic asphalt not to be stored in plant silos for periods in excess of four hours.
- The total time of storage to be limited to 24 hours unless otherwise approved. Storage of mixed asphalt is a WITNESS POINT.

**Manufacture of stone mastic asphalt**

Requirements: The following particular requirements apply to the production of stone mastic asphalt:
- Filler systems to be designed or modified to provide for the appropriate quantity of added filler. In drum mix plants, loss of filler to be minimised by feeding direct into the mixer alongside addition of binder.
- Fibre to be added in a manner that ensures good dispersion of fibres, avoids loss of fibre through dust collection systems and avoids damage to fibre by overheating.
- Mixing times to be increased, where necessary, to ensure adequate dispersal and mixing of fibre.

**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.

**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:
- 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, channels, adjoining structures, traffic and parked vehicles from tack coat spray.
- Where asphalt is to be spread over clean, freshly placed asphalt, or over a clean primed surface, the Superintendent may direct the Contractor to omit the tack coat. This is a **WITNESS POINT**.

Placement of ultra-thin surfacing materials: Modify the tack coating procedure to provide a bond coat consisting of 0.9 L/m² (total) of 62% binder content polymer modified bitumen emulsion. Bitumen emulsion application rates of more than 0.5 L/m² are to be applied through a spray bar mounted directly on the asphalt paver, immediately ahead of the spreading of asphalt.

#### 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 Schedule of Job Details. If no method is specified in the Schedule of Job Details, 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.
Do not use pneumatic tyred rollers in the compaction of open graded asphalt and stone mastic asphalt. The method of compaction of open graded and stone mastic asphalt is to avoid damage to aggregate or drawing of binder to the surface of stone mastic asphalt. Generally apply no more than two vibratory passes using high frequency and low amplitude shall be applied.

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 channel, the surface at the edge of the wearing course to be flush with, or not more than 5 mm above, the lip of the channel, 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>Freeways and highways with high speed traffic</td>
</tr>
<tr>
<td></td>
<td>Parallel to centreline</td>
</tr>
<tr>
<td>Wearing course</td>
<td>3</td>
</tr>
<tr>
<td>Intermediate and base</td>
<td>6</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 Schedule of Job Details.

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 3.5.2 Acceptance constant

<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 3.5.3 Characteristic value of in situ air voids for wearing course asphalt

<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 3.5.4 Characteristic value of in situ air voids for base asphalt

<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

### 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>1144.1 Mix design</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>1144.2 Supply and install asphalt measured by mass unless otherwise specified in the Schedule of Job Details</td>
<td>Tonnes</td>
<td>All costs associated with supply, install and finishing of asphalt.</td>
</tr>
<tr>
<td></td>
<td>- Determine the mass in tonnes from doockets supplied by the Contractor and issued at a certified weighing system by batch weights using certified scales approved by the Superintendent.</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>1144.2 Supply and install asphalt determined from measurement of area and thickness where specified in the Schedule of Job Details</td>
<td>Tonnes</td>
<td>All costs associated with supply, install and finishing of asphalt.</td>
</tr>
<tr>
<td></td>
<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 in situ densities of the lot.</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:
- That the reduced service life arising from the non complying material is offset by reducing payment for the non complying material by the method defined in the Schedule of Job Details; or,
- 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 SEPARATE PAY ITEMS

General

Separate pay items to be included in the Schedule of Rates for each nominal course thickness and each nominal size and type of asphalt specified.

Method

Pay items: To be Measurement by mass or measurement by area and thickness. Any Special Job Requirements listed below to be additional separate Payment Items

Special job requirements (Optional)
- Special design criteria: [complete/delete]
- Approval of job mix: [complete/delete]
- Submission of samples: [complete/delete]
- Method of level control: [complete/delete]
- Measurement of ride quality: [complete/delete]
- Density testing: [complete/delete]
Non-complying materials: [complete/delete]
Removal of thermoplastic or other line marking: [complete/delete]
Additional pavement preparation: [complete/delete]
Other: [complete/delete]

5 SELECTIONS

5.1 SCHEDULE OF JOB DETAILS
Asphalt mix requirements (Quality, Binder, Aggregate grading and binder content, Mix properties)

<table>
<thead>
<tr>
<th>Item</th>
<th>Layer/course</th>
<th>Asphalt mix type/traffic category</th>
<th>Binder class/type</th>
<th>Nominal size</th>
<th>Layer thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
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## 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: _______________________

<table>
<thead>
<tr>
<th>Plan No:</th>
<th>Mix Type:</th>
<th>New Surfacing</th>
<th>Resurfacing</th>
<th>Existing Surface Type:</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Load No.</th>
<th>Time</th>
<th>Paving</th>
<th>Layer</th>
<th>Remarks</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>
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</tbody>
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March 2016
7 ANNEXURE B: NOTES FOR IMPLEMENTATION AND USE OF SPECIFICATION CLAUSES

7.1 GENERAL

Scope
The specification has been prepared for the manufacture, supply and placing of dense graded asphalt (also referred to as asphaltic concrete or AC), open graded asphalt (OGA), stone mastic asphalt (SMA) and fine gap graded asphalt (FGGA) for roadworks and related applications. Different criteria apply to quality of components and asphalt mix design according to the application. The nominal size and types of mixes to be used should be specified in the Schedule of Job Details. The intended use of the materials may also involve the application of different construction requirements and these should also be nominated in the Schedule of Job Details. Guidelines for the application of such requirements are given in the notes to the relevant worksection clauses. Careful consideration of the Schedule of Job Details is required to ensure that asphalt is fit for purpose, of the appropriate type and quality, and provided in a cost effective manner. The terms used in the worksection guidelines are generally consistent with AS 2124, and include Principal, Superintendent, and Superintendent’s Representative. Where these terms are in conflict with those otherwise used, a general interpretation clause should be inserted in the contract documents.

Quality Requirements: The quality requirements of 0161 Quality (Construction) are designed to apply the AUS-SPEC quality system requirements. The following paragraphs may be substituted if desired:
‘The Contractor is to establish, implement and maintain a Quality System in accordance with this worksection and the requirements of AS/NZS ISO 9001, or a recognised equivalent.’
‘Where required in the Contract general clauses, the Contractor is to submit a Quality Plan prior to commencement of any works. The Quality Plan to take into account the specific requirements for inspection and testing, acceptance/rejection criteria, details of proposed methods and other quality requirements that are contained in the Contract Documents. No part of the Quality System is to be used to pre-empt or otherwise negate the technical requirements of the Contract Documents.’
Depending on project type and performance risk, the Principal may undertake an audit of a Contractor’s Quality System and/or Quality Plan as part of prequalification or contract acceptance procedures. The Principal may also establish additional procedures for surveillance of contract activity and audit/verification of quality of materials and testing.

7.2 MATERIALS

Aggregate
The worksection refers to AS 2758.5, which requires the user to select from a number of options for determination of aggregate durability. These options tend to have been developed around the tests considered to provide the most suitable characterisation of the various stone types found in different localities. As a general rule, the standards and the worksection requirements are applied on a State by State basis as follows:
- Soundness based on Los Angeles Abrasion and Unsound Stone Content (Table 2.1) – Victoria and Western Australia.
- Soundness based on 10% Fines Value and Wet/Dry Strength Variation (Table 2.2) – All other States.

Minimum values of polishing resistance (PSV or PAFV) are provided as default values for general application. Surface friction requirements will vary according to the risks associated with operating environment or particular sites, which will also influence the choice of type of asphalt mix and other design factors associated with surface texture. Availability may also be a consideration. This may lead to the adoption of higher or lower minimum polishing values for some applications.

Mineral filler
Some asphalt specifications show confusion over the role and specification of filler in asphalt mixes. By strict definition, filler is that mineral matter passing the 75 micron sieve and includes filler sized particles derived from aggregates as well as added fine materials such as lime, fly ash,
etc. In practice, materials used as added filler are comprised predominately of particles smaller than 75 microns but may also contain a proportion of coarser particles. Tests applied to added filler materials apply to the complete sample, not just that portion passing the 75 micron sieve.

**Binder**
A guide to selection of binder type is provided in the notes to Mix design.

**Reclaimed Asphalt Pavement (RAP)**
A guide to the application of design and manufacturing requirements for RAP in asphalt is provided in the notes to Mix design.

### 7.3 MIX DESIGN

**General**
Gyratory compaction enables ready selection of different compaction levels to match expected service conditions as well as being able to simulate long term heavy traffic loadings by extended compaction. Gyratory compaction is also considered to achieve particle alignment that is a better representation of field compaction of asphalt. The specification also provides for the use of Marshall compaction where that method of compaction is preferred. It is important that only one set of criteria are applied, either Marshall or gyratory compaction. In due course it is expected that gyratory compaction will become more common than Marshall.

The mechanical properties of Marshall ‘Stability’ and ‘Flow’ do not directly measure fundamental properties but provide empirical relationships that have been found to correlate with asphalt mixes that provide suitable levels of field performance.

Several relatively new performance-based design criteria have been developed through the national research programs of AAPA, Austroads and ARRB Transport Research. The outcome of that research program has been published as AGPT04B Appendix A Mix design procedures.

**Aggregate grading and binder content**
The aggregate grading and binder content ranges shown in Tables 3.7, 3.8, 3.9, 3.10 and 3.11 of the worksection are targets for design purposes. Application of production tolerances may result in actual production being outside those limits. Table 3.7 restricts the proportion of finer materials in order to provide good texture for dense graded wearing course mixes for medium and heavy traffic and increased deformation resistance in heavier trafficked applications. Table 3.8 allows increased proportions of finer materials in dense graded mixes for all lesser trafficked applications.

The Superintendent may approve the use of asphalt mixes with a design target outside the ranges shown where it can be shown that all the other performance requirements can be adequately met.

**Mix properties - Selection of Mix Type, Binder Type, and Layer Thickness**
The principal factors influencing the performance characteristics of asphalt mixes are:

- The selection and quality of components.
- The volumetric properties of the mix (nominal size, grading, binder content and voids relationships) and the layer thickness.

The worksection provides for different criteria for aggregate quality and voids relationships for dense graded mixes based on traffic categories. A guide to selection of traffic category is shown in the Table B1 below. The relevant traffic category should be nominated in the Schedule of Job Details.

The mix type, nominal mix size, binder type and layer thickness should also be nominated in the Schedule of Job Details.

For most wearing course and structural asphalt applications, dense graded asphalt mix types are used. Other mix types are used as wearing course to provide particular surface characteristics for particular applications as follows:

- Open graded asphalt is used as a porous wearing course to reduce water spray and tyre noise levels on freeways and other high speed roads.
- Ultra thin asphalt (UTOGA) is a specialty asphalt mix for placing in thin layers (12–15 mm compacted thickness). It uses a modified grading to improve resistance to surface shearing forces, which reduces porosity but still provides coarse textured surface. UTOGA must be placed in conjunction with a heavy tack coat (see Section 3.4), sprayed seal or strain alleviating membrane interlayer (SAMI) to ensure strong bond to underlying surface.
- Stone mastic asphalt (SMA) is used to provide good surface texture and good deformation resistance on heavily trafficked roads. Smaller nominal sizes can also be used as a durable, well-textured surface in lightly trafficked applications.
Fine gap graded asphalt (FGGA) provides a very fine textured surface in a mix that can be readily compacted to low air voids thereby providing good durability in lightly trafficked pavements. The grading envelope for FGGA provides for a wide choice of grading target but there is a design intent to produce a gap grading with limited intermediate sized aggregate fractions as described in Chapter 6 of APRG 18. While the grading and binder content produces a more workable mix, it can be more susceptible to deformation and is not appropriate for heavily trafficked or highly stressed areas.

A detailed guide to selection of different wearing course asphalt mixes for particular surface characteristics is provided in Austroads AGPT03/09-2009 Guide to Pavement Technology – Pavement surfacings.

The nominal size may be determined as a function of the layer thickness or the layer thickness selected on the basis of the nominal size required for a particular application. A guide to selection of layer thickness and nominal size is shown in Table B2.

Guides to selection of binder types for dense graded wearing and base course applications are shown in Tables B3 and B4. Not all binder types may be available in all locations and AR450 has only recently been introduced in NSW. Modified binders require delivery in minimum quantities and special handling and storage requirements. The specification of modified binders may, therefore, not be practical for small projects or remote locations. Before specifying a particular binder, the designer should ascertain the availability in the project location.

It should be noted that:
- The air void range for gyratory compaction of dense graded mixes are different to those for Marshall compaction.
- The limits for gyratory compaction are based on different compactive effort (cycles) for different traffic applications.
- The air void range for Marshall compaction provide the option of varying compactive effort for different traffic levels, or choosing a different air void range based on a single 50-blow compactive effort. The use of 50-blow compaction enables mixes of different applications and air voids to be selected from the one set of laboratory test data.
- If mixes are to be designed for different Marshall compactive effort, the air void range and VMA should be reduced by up to 1% for 75-blow compaction and increased by up to 1% for 35-blow compaction. Where different air voids criteria are required, a special clause should be inserted in the schedule of details.

### Table B1 Guide to Traffic Category

<table>
<thead>
<tr>
<th>Indicative Traffic Volume</th>
<th>Structural design level</th>
<th>Free flowing vehicles</th>
<th>Stop/start OR climbing lane OR slow moving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial vehicles/lane/day</td>
<td>&lt; 100</td>
<td>&lt; 5x10^5 ESAs</td>
<td>Light</td>
</tr>
<tr>
<td></td>
<td>100–500</td>
<td>5x10^5–5x10^6 ESAs</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>500–1000</td>
<td>5x10^6–2x10^7 ESAs</td>
<td>Heavy</td>
</tr>
<tr>
<td></td>
<td>&gt; 1000</td>
<td>&gt; 2x10^7 ESAs</td>
<td>Very heavy</td>
</tr>
</tbody>
</table>

### Table B2 Guide to selection of nominal size of dense graded mixes

<table>
<thead>
<tr>
<th>Nominal size (mm)</th>
<th>Typical layer thickness (mm)</th>
<th>Typical use</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>15–20</td>
<td>Very thin surfacing layer with fine surface texture. May not be available in all locations</td>
</tr>
<tr>
<td>7</td>
<td>25–30</td>
<td>Commonly used for surfacing residential streets and foot traffic areas where thin layers and fine surface texture are required.</td>
</tr>
<tr>
<td>10</td>
<td>30–45</td>
<td>General purpose wearing course in light and medium traffic applications</td>
</tr>
<tr>
<td>14</td>
<td>40–55</td>
<td>Wearing course mix for heavier traffic applications. Also some intermediate course applications depending on layer thickness</td>
</tr>
<tr>
<td>20</td>
<td>60–90</td>
<td>General purpose base and intermediate course mix for wide range of use.</td>
</tr>
</tbody>
</table>
### Table B3 Selection of binder type for dense graded wearing course applications

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Binder Class/Type</th>
<th>Recommended use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>320 or 320 or 170</td>
<td>Residential streets, car parks and foot traffic</td>
</tr>
<tr>
<td></td>
<td>320 or 450</td>
<td>Alternative to 320, particularly in warmer climates</td>
</tr>
<tr>
<td>Medium</td>
<td>320 or 320 or 450</td>
<td>Normal conditions and lower traffic ranges, particularly in cooler conditions</td>
</tr>
<tr>
<td></td>
<td>320 or 320 or 450</td>
<td>Good general purpose mix for wide range of applications</td>
</tr>
<tr>
<td>Heavy</td>
<td>320 or 320 or 450</td>
<td>General purpose mix for heavily trafficked applications.</td>
</tr>
<tr>
<td></td>
<td>320 or 320 or 450</td>
<td>Higher performance mixes for more critical traffic applications or</td>
</tr>
<tr>
<td></td>
<td>600, 320, AR450</td>
<td>where elastomeric polymers are required to improve flexibility.</td>
</tr>
<tr>
<td></td>
<td>Multigrade or PMB</td>
<td>Stiffer binders require strong, stiff base.</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>320 or 320 or 450</td>
<td>Heavily trafficked intersections and slow moving traffic</td>
</tr>
<tr>
<td></td>
<td>600, 320, AR450</td>
<td>Special applications such as very heavily trafficked intersections and</td>
</tr>
<tr>
<td></td>
<td>Multigrade or PMB</td>
<td>heavy-duty industrial pavements.</td>
</tr>
</tbody>
</table>

### Table B4 Selection of binder type for dense graded intermediate and base course applications

<table>
<thead>
<tr>
<th>Traffic Category</th>
<th>Binder Class/Type</th>
<th>Recommended use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light and Medium</td>
<td>320</td>
<td>General purpose mixes for cooler conditions</td>
</tr>
<tr>
<td></td>
<td>320 or 320 or 450</td>
<td>General purpose mixes for most light and medium traffic applications</td>
</tr>
<tr>
<td>Medium/Heavy (high</td>
<td>320 or 320 or 450</td>
<td>Special high bitumen content sub-base layer providing high fatigue resistance.</td>
</tr>
<tr>
<td>fatigue base)</td>
<td></td>
<td>To avoid rutting, this mix should not be used within 125 mm of surface.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The layer thickness should not generally exceed 70 mm or one third of the</td>
</tr>
<tr>
<td></td>
<td></td>
<td>structural pavement depth.</td>
</tr>
<tr>
<td>Heavy</td>
<td>320 or 320 or 450</td>
<td>General purpose mix for heavy traffic applications.</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>High stiffness base for use in heavy duty pavements.</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>320, 450, 600,</td>
<td>Special applications such as heavy-duty industrial pavements and</td>
</tr>
<tr>
<td></td>
<td>Multigrade or PMB</td>
<td>hard standing areas.</td>
</tr>
</tbody>
</table>

### Table B5 Selection of binder type for other mix types

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>Traffic Category</th>
<th>Binder Class/Type</th>
<th>Recommended use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Graded Asphalt</td>
<td>Light or Medium</td>
<td>320 or 450</td>
<td>Wearing course on light to medium trafficked roads where low levels of noise and</td>
</tr>
<tr>
<td></td>
<td>Heavy or Very</td>
<td>PMB</td>
<td>Wearing course on Freeways and other heavily trafficked roads where low levels</td>
</tr>
<tr>
<td></td>
<td>Heavy</td>
<td></td>
<td>of noise and water spray are required.</td>
</tr>
<tr>
<td>Stone Mastic Asphalt</td>
<td>Light or Medium</td>
<td>320 or 450</td>
<td>Wearing course for light and medium trafficked roads where well textured mix is</td>
</tr>
<tr>
<td></td>
<td>Heavy or Very</td>
<td>PMB</td>
<td></td>
</tr>
<tr>
<td>Mix Type</td>
<td>Traffic Category</td>
<td>Binder Class/Type</td>
<td>Recommended use</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------</td>
<td>-----------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fine Gap Graded Asphalt</td>
<td>Light</td>
<td>320 or 450</td>
<td>Fine textured, durable wearing course for use in residential streets, pedestrian areas, and other light traffic applications</td>
</tr>
<tr>
<td>Heavy or Very Heavy</td>
<td>320, 450 or Multigrade</td>
<td></td>
<td>Wearing course for heavily trafficked roads providing high levels of texture and rut resistance.</td>
</tr>
<tr>
<td>Very Heavy (Special applications)</td>
<td>PMB</td>
<td></td>
<td>Enhanced wearing course performance in heavily trafficked applications.</td>
</tr>
</tbody>
</table>

**Design and manufacture of asphalt mixes incorporating Reclaimed Asphalt Pavement (RAP)**

As a general rule, no special requirements need apply to the use of RAP in hot mix asphalt. Where the percentage of RAP does not exceed 15% of the total mix, provided that separate designs are prepared for such mixes, the proportions used in manufacture are not substantially altered from that used in design, and that the Quality Plan includes a reasonable management plan for monitoring incoming RAP materials. Where RAP is to be added in proportions greater than 15%, but not more than 30% of the total mix, the use of bitumen binder of one class softer than that otherwise specified will generally provide suitable compensation for the influence of hardened binder in the RAP and produce asphalt mixes of comparable stiffness, fatigue resistance and deformation resistance to mixes manufactured with virgin materials.

Alternative procedures include the use of rejuvenators or a softer class of binder tailored to tests on actual penetration or viscosity of binders recovered from stockpiled RAP materials. The latter approach is appropriate where it is believed that accurate prediction of binder stiffness is critical to the long term performance of the asphalt, e.g. Heavy traffic base applications and Very Heavy traffic base and wearing course applications. A further option is to accept the material without adjustment to the grade of fresh binder. In such cases the asphalt may have slightly higher flexural stiffness that could reduce fatigue resistance in thin surfacing applications when the proportion of RAP approaches 25 or 30%.

The specifier may also restrict use of more than 15% RAP to particular mix types or project applications. Mixes that are not permitted to contain more than 15% RAP should be listed in the Schedule of Job Details. The use of RAP in proportions greater than 15% should not be allowed where polymer modified binders are specified but should be satisfactory for use with multigrade binder and most applications with standard classes of bitumen binder.

The use of RAP in proportions greater than 30% of the total mix should only be permitted where the Contractor can demonstrate suitable manufacturing plant and quality control procedures. Manufacture should only be carried out in asphalt plants specifically designed to handle such proportions of RAP without overheating and damage to binder in the RAP or new mix. The quality plan should indicate the procedures for monitoring the consistency of grading and binder properties of incoming RAP materials, the use of softer binders or rejuvenating agents to achieve a binder of comparable performance to that otherwise specified, and testing to validate the properties of the manufactured asphalt.

A guide to blending of binders or rejuvenating agents to achieve a target binder viscosity is provided in *the Austroads* AGPT04B and AGPT04E (Recycled materials). Caution must be used in determining targets for blending of binders as fresh binder or rejuvenator may not be fully combined with the aged binder during the asphalt manufacture process. Consequently, mix performance characteristics imparted by binder stiffness, particularly fatigue and rutting resistance, may be somewhat intermediate between that of the fresh binder and that predicted from the stiffness or viscosity calculated or determined by extraction and testing of the blended binder.

### 7.4 MANUFACTURE AND STORAGE

Guidance for binder storage and mixing temperatures may be obtained by reference to AAPA Advisory Note 7: *Guide to the Heating and Storage of Binders for Sprayed Sealing and Hot Mixed Asphalt*. Also see AGPT04K for more information on seals. The length of time that manufactured asphalt may be held in hot storage bins will vary according to the type of mix, type of binder and construction of storage bins. Maximum storage times (24 h) are generally applicable to standard
dense graded asphalt mixes, standard bitumen binder and well insulated bins that may also include supplementary heating. Shorter storage periods apply to high binder content mixes, polymer modified binders and poorly insulated bins. Additional guidelines for storage of polymer modified binders at elevated temperatures may be provided by the manufacturers of polymer modified binders. Other potential deleterious influences of extended storage may be assessed by monitoring mix temperature variation and segregation.

The addition of fibre to stone mastic asphalt is generally undertaken by one of the following alternative methods:
- Addition of loose or pelletised fibre direct to the pugmill of a batch mixer in meltable pressed packs
- Metering of loose or pelletised fibre direct to pugmill of batch mixing plant
- Metering of pelletised fibre through system designed for addition of RAP to drum mixing plant.
- Metering of loose or pelletised fibre direct to drum mixing plant through line that merges fibre with binder at point of addition to aggregates.

7.5 SAMPLING AND TESTING OF ASPHALT PRODUCTION

General: The purpose of inspection and testing is to provide reasonable assurance to the purchaser that the quality of component materials comply with the standards specified, and that the manufactured asphalt is in accordance with the designated job mix design.
Manufacturing compliance may be assessed at two levels:
- Verification that the job mix has been replicated, i.e. use of conforming components and combination in the design proportions to achieve the job mix grading and binder content.
- Verification that the design targets have been met, i.e. testing of compacted samples for volumetric properties and other specified properties.

For many applications, compliance with the job mix grading and binder content is adequate. If production is controlled within the tolerances specified, it is neither necessary nor cost effective to perform further testing for conformity to mix design criteria as a routine measure of quality. In fact, the variability inherent in such sampling and testing may lead to misleading interpretation of quality variation where no such variation really exists.
Where confirmation of volumetric properties is required, an additional clause should be inserted to require compaction of samples taken from production to be compacted using the same procedures as that specified for the design of the relevant mix. The sampling frequency should be the same as that applied to testing of grading and binder content.
Compacted samples may also be assessed for other design properties such as Marshall Stability and flow or resilient modulus. The Marshall test properties should meet the specified design criteria.
The manufacturer should not rely solely on the sampling and testing done for compliance purposes as the measures of process quality control. The worksection provides an incentive to the manufacturer to undertake suitable measures to improve the level of conformity and consistency of manufactured product by reducing the frequency of testing for compliance purposes where the manufacturer is using a suitable statistical process control system and where the results of compliance tests show an appropriate level of consistency in meeting the worksection requirements.
A guide to statistical process control systems is provided in AAPA Implementation Guide IG-3: Asphalt Plant Process Control Guide. Further guidance to the application of statistical techniques is provided in AS 3940 Quality control – Guide to the use of control charts including Cusum techniques and AS 3942 Quality control – Variables charts – Guide.
A typical statistical process control system that would be suitable for this application is one that incorporates the following elements:
Process control charts for the compliance tests for grading (one sieve below mix nominal size, 2.36 mm and 0.075 mm sieves), binder content, and maximum density.
Process charts should show:
- Actual individual sample test results plotted against the target value and specified tolerances.
- Five point rolling mean, with the target value, warning and control limits.
- Five point rolling range (the maximum of five points).
Corrective action should be taken when any of the following occur:
- One point lies outside the control limits.
- Two out of three points lie outside the warning limits. Investigation of possible assignable causes, and need for corrective action, should be undertaken if:
- Five consecutive points in the rolling mean are above or below the target.
- Five consecutive increasing points occur in the range.
- Two out of three points lie outside the warning limits.

The use of statistical process control measures are strongly encouraged as a means of reducing the uncertainties associated with interpretation of test results from single samples. The use of risk assessment procedures to define where variation may occur is also recommended.

### 7.6 DELIVERY

The rate of delivery should be matched to paving output to maintain consistent spreading to achieve good ride quality and uniform compaction and to avoid unnecessary delays in spreading operations and loaded asphalt being held on site for long periods.

Asphalt should arrive on site at a suitable temperature for spreading. The actual temperature will depend on mix type, layer thickness, ambient conditions and equipment available for compaction. Generally, compaction should be completed before the mix temperature falls below about 90°C (slightly higher for modified binders). A guide to temperature of dense graded hot mix asphalt mixes, at the time of spreading, to provide adequate time for compaction using typical equipment, is shown in Table B6.

**Table B6 Asphalt Spreading Temperatures (Dense Graded Asphalt)**

<table>
<thead>
<tr>
<th>Road surface temperature1 (°C)</th>
<th>Minimum mix temperature2 (°C)</th>
<th>Range of mix temperature3 (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness of layer, mm</td>
<td>&lt; 30</td>
<td>30 – 40</td>
</tr>
<tr>
<td>5 – 10</td>
<td>See note 4</td>
<td>See note 4</td>
</tr>
<tr>
<td>10 – 15</td>
<td>150</td>
<td>145</td>
</tr>
<tr>
<td>15 – 25</td>
<td>150</td>
<td>145</td>
</tr>
<tr>
<td>&gt; 25</td>
<td>150</td>
<td>145</td>
</tr>
</tbody>
</table>

Notes:
1. Surface temperature should be generally that applicable to the coolest area of the pavements, e.g., shade areas, if applicable.
2. Mix temperatures apply to Classes 170, 320 and AR450 bitumen binder. Use of Class 600, Multigrade, or PMBs may require minimum temperatures 5°C to 10°C higher than those shown.
3. Maximum temperatures apply when placing thick layers, to avoid excessive displacement under rolling.
4. Placing asphalt in thin layers under cool conditions may adversely affect the result due to the increased difficulty in achieving proper compaction, effective joints and good surface finish. Additional attention should be paid to issues of mix workability, asphalt temperature, compaction techniques and any influence from additional cooling due to wind or moisture.
5. Placing of asphalt over a previous layer that has not cooled below about 65°C requires special consideration and mix temperatures should be adjusted accordingly.

### 7.7 PLACING

**Preparation of surface**

Road surfaces must be clean to ensure good bond between new asphalt and the existing surface.

**Priming**

Crushed rock and gravel surfaces should be primed with a suitable application of primer, prior to placing asphalt, particularly where the total thickness of asphalt is 50 mm or less. Priming the surface assists in:

- Achieving a strong bond between asphalt and granular layers.
- Reducing the permeability of the surface of the granular layer.
- Stabilising the pavement moisture content and assisting in the curing of cement stabilised layers.
- Preserving the integrity of the granular surface after completion of preparation and before placing asphalt.

If priming is required, it must be included as a separate worksection and schedule item.

**Tack coating**

Tack coating for normal asphalt applications comprises a light application of bitumen emulsion to ensure adequate adhesion between layers. The placing of ultra thin asphalt is a specialty process that requires a higher application rate of tack coat (up to 0.9 L/m²) to increase the surface bond. The type of bitumen emulsion used in such applications generally contains a polymer modifier and must be placed with a special integrated paving machine that sprays tack coat immediately ahead of depositing asphalt so that the tack coat is not damaged by spreading equipment.

The type of bitumen emulsion for normal applications should suit the conditions of use. Generally, rapid setting cationic emulsion is used in cooler regions where damp conditions may be encountered. In warmer or drier conditions, slower setting cationic emulsions and anionic emulsions may combine easier handling with satisfactory performance. Bitumen emulsion used for tack coating may be diluted with water to assist uniform coverage, provided that the residual binder application rate is achieved.

Tack coating is generally not necessary when placing over clean, freshly applied primed surfaces or newly placed, untrafficked asphalt.

**Spreading**

The specification provides for asphalt to be placed when pavement surface temperatures are as low as 5°C. Placing in cool conditions increases the difficulty in obtaining good standards of work and, where practicable, work involving thin layers (40 mm or less) or PMB binders should be programmed to be done when such conditions are less likely to occur.

The selection and use of automatic level control for asphalt paving should normally be determined by the Contractor, taking into account the applicability to site conditions and the geometric requirements of the finished result. The use of automatic level controls will usually only be applicable to larger jobs and heavier traffic. The Schedule of Job Details provides for specification of particular level control devices, if required.

**Compaction**

Selection of compaction equipment is the responsibility of the Contractor, provided that it is capable of achieving the required standards of compacted density, surface shape and finish.

**Joints**

Joints are the weakest part of the pavement. Cold joints should be minimised by planning of works to achieve a minimum number of construction joints and, where practicable, maximum use of hot or warm joints.

### 7.8 FINISHED PAVEMENT PROPERTIES

For general asphalt work, the application of shape standards as specified in Shape, together with the use of good placing practices as outlined in the notes to Placing, should provide adequate surface smoothness and ride quality.

The standard of ride quality that can be achieved will depend on:
- The roughness of the surface on which the asphalt layer is to be placed, and
- The extent of shape correction and additional asphalt layers that may be applied prior to the final layer.
- Ride quality will also be influenced by restrictions such as intersecting streets, road fixtures (e.g., manholes), and the need to match kerb and channel. Specifiers should avoid potential conflicts in requirements by simultaneously trying to control thickness, level and ride quality.

Achievement of specified densities will depend upon the provision of a stiff base and a workable mix.

### 7.9 MEASUREMENT AND PAYMENT

Payment is normally on the basis of mass determined from an approved weighing system. Alternatively, on new works where asphalt is being placed to a specified thickness, the mass may be determined on the basis of measured area, thickness and density.

Additional clauses may also be inserted to apply a scheduled rate of reduction in payment for failure to comply with manufacturing targets, compacted density and ride quality requirements to compensate for reduced service life.
Schedule of job details
ASPHALT MIX REQUIREMENTS: See Quality, Binder, Aggregate grading and binder content, Mix properties. Insert type/traffic category of mix, binder type, nominal size and thickness, where applicable.

Measurement and payment
MEASUREMENT AND PAYMENT: See Measurement and payment. Indicate the method of measurement applicable.

Special job requirements
SPECIAL JOB REQUIREMENTS: Where required, special clauses should be prepared and inserted for the following:
- Special Design Criteria: See Mix properties. Insert any special design requirements, if applicable.
- Use of Reclaimed Asphalt Pavement (RAP): See Design of asphalt mixes incorporating reclaimed asphalt pavement (RAP). Insert any particular conditions or restrictions to mix types or applications of RAP in asphalt.
- Submission of Samples: See Approval of job mix. Insert details for delivery of samples (if relevant).
- Automatic Paver Level Control: See Tack coating. Insert any special requirements for use of automatic paver control, if applicable.
- Measurement of Ride Quality: See Non complying materials. Insert special requirements for measurement of ride quality, if applicable. A separate schedule item should be provided for the cost of testing, where testing is to be provided by the Contractor.

Non Complying Materials: See Non complying materials. Insert special requirements for payment for non complying materials, if applicable.
1145 SEGMENTAL PAVING

1 GENERAL

1.1 RESPONSIBILITIES

Objectives
General: Provide segmental paving, as documented.
Performance
Requirements: [complete/delete]
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1113 Stabilisation.
- 1121 Open drains, including kerb and channel (gutter).
- 1132 Lean mix concrete subbase.
- 1133 Plain and reinforced concrete base.
- 1141 Flexible pavement base and subbase.
[complete/delete]

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
Australian standards
AS 1141 Methods for sampling and testing aggregates
AS 1141.11.1-2009 Particle size distribution — Sieving method
AS 2876-2000 Concrete kerbs and channels (gutters) – Manually or machine placed.
AS 3705-2012 Geotextiles-Identification, marking and general data
AS/NZS 4455 Masonry units, pavers, flags and segmental retaining wall units
AS/NZS 4455.2:2010 Pavers and flags
AS/NZS 4456 Masonry units and segmental pavers — Methods of test
AS/NZS 4456.3:2003 Determining dimensions
AS/NZS 4456.5:2003 Determining the breaking load of segmental pavers and flags
AS/NZS 4456.9:2003 Determining abrasion resistance
AS/NZS 4456.10:2003 Determining resistance to salt attack
AS/NZS 4586:2004 Slip resistance classification of new pedestrian surface materials
AS/NZS 4663:2004 Slip resistance measurement of existing pedestrian surfaces
Austroads Guide to pavement technology: Part 4G Geotextiles and geogrids
AGPT04G-2009

Other publications
Concrete Masonry Association of Australia
CMAA MA56-2010 Guide to permeable interlocking concrete pavements
CMAA MA57-2010 Guide to concrete segmental and flag pavements - guide to specifying
CMAA T45-1997 Concrete segmental pavements - Design guide for residential access ways and roads
CMAA T46-1997 Concrete segmental pavements - Detailing guide
1.4 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the following abbreviations apply:
- CBPI: Clay Brick and Paver Institute, now known as Think Brick Australia.
- CMAA: Concrete Masonry Association of Australia.

Definitions
General: For the purposes of this worksection the following definitions apply:
- Clay pavers: Manufactured from clay, shale or argillaceous materials which may be mixed with additives. Clay pavers may have square, bevelled (chamfered), rounded or rumbled edges. They are generally rectangular in shape, with the length twice the width, plus 2 mm.
- 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.
- Manuals: [complete/delete]
- Prototypes: [complete/delete]
- Samples: [complete/delete]
- Warranties: [complete/delete]

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>MATERIALS</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>EXECUTION</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>SUBBASE – Dimensions and specification</td>
<td>Present finished subbase for approval</td>
<td>1 working day before proceeding</td>
<td>Principal Certifying Authority</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.
- Slip resistance site test of completed paving: To AS/NZS 4663.
- The source of supply.
Testing authority: NATA registered laboratory.
Approval: Do not deliver materials until the Superintendent has approved the nominated materials. Inspection type: HOLD POINT.

3.2 CONCRETE AND CLAY 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 MA 56 Section 9.  
Moisture content: Dry when spread.

3.4 GEOTEXTILE MATERIALS

**General**
Standard: To AS 3705 and AGPT04G.

**Type:** [complete/delete]

3.5 CONCRETE FOR EDGE RERAINTS

**Properties**
General: To 0319 *Minor concrete works*.
Strength: If not shown on the drawings, or provided by kerb and/or gutter (channel), 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*.

<table>
<thead>
<tr>
<th>Property</th>
<th>PAV1</th>
<th>PAV2</th>
<th>PAV3</th>
</tr>
</thead>
</table>

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### 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 channel (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.

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

5 MEASUREMENT AND PAYMENT

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 channel (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>
<tbody>
<tr>
<td>1145.1 Edge strips</td>
<td>Linear metre Measured along the length of the edge strip</td>
<td>All costs associated with the following: Excavation, forming, concreting, contraction joints, backfilling and compaction adjacent to the completed edge strip.</td>
</tr>
<tr>
<td>1145.2 Segmental paving—Road pavements</td>
<td>m² The surface area of segmental paving for road and driveway pavements calculated from the width and length as shown on the drawings or as directed by the Superintendent.</td>
<td>All costs associated with the following: Supply, laying and compaction of segmental paving units, bedding sand and joint filling sand. Cutting of units. Joints overlying concrete pavement joints. 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: [complete/delete]

Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 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:
AS 1141 Methods for sampling and testing aggregates.
AS 1141.11.1-2009 Particle size distribution by dry sieving.
AS 1141.22-2008 Wet/dry strength variation.
AS 1289 Methods of testing soils for engineering purposes.
AS 1289.5.5.1-1998 Soil compaction and density tests - Determination of the minimum and maximum dry density of a cohesionless material - Standard method.
AS 1289.5.6.1-1998 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material
AS/NZS 1477-2006 PVC pipes and fittings for pressure applications.
AS 2439 Perforated plastics drainage and effluent pipe and fittings.
AS 2439.1-2007 Perforated drainage pipe and associated fittings.
AS 2758 Concrete aggregates.
AS 3705-2012 Geotextiles - Identification, marking and general data.
AS 3706 Geotextiles - Methods of test.
AS 3706.9-2012 Determination of permeability, permeability and flow rate.
AS 3706.11-2012 Determination of durability—Resistance to degradation by light, heat and moisture.

Other publications
AUSTROADS
AGPT04G-2009 Guide to Pavement Technology Part 4G- Geotextiles and geogrids
AGPT10-2009 Guide to Pavement Technology Part 10– Subsurface drainage
ASTM D2434-68-2006 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.

Design: [complete/delete]
Manuals: [complete/delete]
Prototypes: [complete/delete]
Evidence of type tests: [complete/delete]
Warranties: [complete/delete]

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>MATERIALS</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>Principal Certifying Authority</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>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>EXECUTION</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>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Excavation -</td>
<td>Approval of completed</td>
<td>1 working day prior to</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>
1171 Subsurface drainage

<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>Trenches</td>
<td>trenches required prior to installation of drainage work</td>
<td>installation of drainage work</td>
<td>Authority</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>Principal Certifying Authority</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 ‘Megaflo’ 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.
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 Drainage mats.

<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 Drainage mats.

<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>
</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>± 0.5</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 v 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. Seek a direction from the Superintendent for any changes that may effect the Schedule of rates. 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>
<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></td>
<td></td>
</tr>
<tr>
<td>Transmission</td>
<td>&gt; 50 l/m²/s</td>
<td>Geotextile</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

### 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>
</table>
| 1171.1 Filter material Type A backfill | - Compacted m³  
- 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. | - 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 Subsurface drainage

<table>
<thead>
<tr>
<th>Pay items</th>
<th>Unit of measurement</th>
<th>Schedule rate scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>1171.2 Filter material Type B backfill</td>
<td>Compacted m³</td>
<td>- All costs associated with supply, placement and compaction of filter material and the capping of the trench where shown on the drawings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1171.3 Filter material Type C backfill</td>
<td>Compacted m³</td>
<td>- All costs associated with supply, placement and compaction of filter material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule rate is a provisional quantity.</td>
</tr>
<tr>
<td>1171.4 Filter material Type D backfill</td>
<td>Compacted m³</td>
<td>- All costs associated with the supply, placement and compaction of filter material.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>1171.5 Outlet structures for subsurface drainage pipes</td>
<td>Each outlet structure..</td>
<td>- Outlet structures in conformance with this worksection excluding outlets into pits.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- 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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- The schedule quantity is a provisional quantity.</td>
</tr>
</tbody>
</table>

6 ANNEXURE A

6.1 SLOTTING DETAILS FOR THICK WALLED PVC PLASTIC PIPE

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 can not 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

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).

1.2 CROSS REFERENCES

Worksections
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 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:
AS 1289 Methods of testing soils for engineering purposes.
AS 1289.5.4.1-2007 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio.
AS 1289.5.6.1-1998 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material

Other publications
AUSTROADS

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.

Design: [complete/delete]  
Manuels: [complete/delete]  
- Detailed records and Work-as-Executed drawings.

Samples: [complete/delete]  
Evidence of type tests: [complete/delete]  
Warranties: [complete/delete]

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</td>
<td>3 working days before</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td></td>
<td>laid to line and grade</td>
<td>next activity</td>
<td></td>
</tr>
<tr>
<td>Subsoil / Foundation drains - Excavation</td>
<td>Inspect excavation</td>
<td>1 working day prior to</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td>filling</td>
<td></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</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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. 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 worksection 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 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.

4.7 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>
</tbody>
</table>
### Activity Limits/Tolerances Worksection Clause/subclause

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laying of pipe</td>
<td>Compaction &gt; 95% (Standard compaction)</td>
<td>Subsoil drains</td>
</tr>
<tr>
<td>Alignment</td>
<td>Deviation &lt; 100 mm from the documented line at any point</td>
<td>Subsoil drains</td>
</tr>
</tbody>
</table>

#### Subsoil drain backfill

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer thickness</td>
<td>300 mm max</td>
<td>Subsoil drains</td>
</tr>
</tbody>
</table>

#### Outlet spacing

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 m max</td>
<td></td>
<td>Outlets</td>
</tr>
</tbody>
</table>

#### Cleanout spacing

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 - 140 m approx</td>
<td></td>
<td>Cleanouts</td>
</tr>
</tbody>
</table>

#### Foundation drain backfill

<table>
<thead>
<tr>
<th>Activity</th>
<th>Limits/Tolerances</th>
<th>Worksection Clause/subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layer thickness</td>
<td>300 mm max</td>
<td>Foundation drains</td>
</tr>
</tbody>
</table>

#### 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>- 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>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| 1172.2 Subsoil drain pipe—100 mm dia slotted corrugated plastic pipe    | Linear metre        | - The disposal of material from drain excavation.  
- The schedule quantity is a provisional quantity.  
All costs associated with:  
- Supply and laying of the subsoil pipe including connections, markers, fittings and seamless tubular filter fabric where documented.  
- The schedule quantity is a provisional quantity. |
| 1172.3 Subsoil drain pipe—corrugated flat plastic pipe                  | Linear metre        | - Measured along the length of the pipe.  
All costs associated with:  
- Supply and laying of the subsoil pipe including connections, markers, fittings and seamless tubular filter fabric where documented.  
- The schedule quantity is a provisional quantity. |
| 1172.4 Supply, placement and compaction of backfill material (other than filter material) for subsoil and foundation drains | m³                  | - Calculated from width, depth and length of compacted backfill in the trench as shown on the drawings, directed by the Superintendent and determined at the time of excavation.  
- The sides of the trench are taken as vertical.  
All costs associated with:  
- Supply, placement and compaction of documented material.  
- The schedule of quantity is a provisional quantity. |
| 1172.5 Supply and placement of geotextile                               | m²                  | - Area covered by geotextile as measured on site.  
All costs associated with:  
- Supply, placement and securing of the geotextile material.  
- No additional payment for additional geotextile used in lap joints.  
- The schedule quantity is a provisional quantity. |
| 1172.6 Cleanout structures                                              | Each                | - Cleanout structure constructed in conformance with the drawings.  
All costs associated with:  
- 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.  
- The schedule quantity is a provisional quantity. |
1173 Pavement drains

1173 PAVEMENT DRAINS

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.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 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:
AS 1289 Methods of testing soils for engineering purposes
AS 1289.3.3.1-2009 Soil classification tests—Calculation of the plasticity index of a soil
AS 1289.5.4.1-2007 Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
AS 1289.5.6.1-1998 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material

Other publications
AUSTROADS AGPT10-2009 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.

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.

Design: [complete/delete]
Drawings: [complete/delete]
- Work as executed drawings.
Calculations: [complete/delete]
Manuals: [complete/delete]
Samples: [complete/delete]
Evidence of type tests: [complete/delete]
Warranties: [complete/delete]

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.

<table>
<thead>
<tr>
<th>HOLD POINTS table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item/Clause title</td>
</tr>
<tr>
<td>-------------------</td>
</tr>
<tr>
<td>EXECUTION</td>
</tr>
<tr>
<td>Sub-pavement</td>
</tr>
<tr>
<td>drains - Laying of</td>
</tr>
<tr>
<td>pipe</td>
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<td></td>
</tr>
<tr>
<td>Intra-pavement</td>
</tr>
<tr>
<td>drains - Laying of</td>
</tr>
<tr>
<td>pipe</td>
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<tr>
<td></td>
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<tr>
<td>Intra-pavement</td>
</tr>
<tr>
<td>drains - Laying of</td>
</tr>
<tr>
<td>pipe</td>
</tr>
<tr>
<td>Edge drains -</td>
</tr>
<tr>
<td>Laying of pipe</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WITNESS POINTS table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item/Clause title</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>EXECUTION</td>
</tr>
<tr>
<td>Establishment -</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>- Laying of pipe</td>
</tr>
<tr>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>- Backfilling</td>
</tr>
<tr>
<td>Edge drains -</td>
</tr>
<tr>
<td>Excavation</td>
</tr>
<tr>
<td>Edge drains -</td>
</tr>
<tr>
<td>Laying of pipe</td>
</tr>
<tr>
<td>Clean outs – Field testing</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.
1173 Pavement drains

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.
Flush: 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 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.
4.10 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</td>
<td></td>
<td>Sub-pavement drains</td>
</tr>
<tr>
<td>Trench Grade</td>
<td>≥ 0.5%</td>
<td>Edge 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>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) of backfill material</td>
<td>100% (Standard compaction)</td>
<td>Edge drains</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

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 Asphaltic 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><strong>1173.1 Excavation</strong></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><strong>1173.2 Subsoil drain pipe</strong></td>
<td>Linear metre</td>
<td>All costs associated with the following:</td>
</tr>
<tr>
<td>- 1173.2(1) 100 mm dia slotted</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>corrugated plastic pipe.</td>
<td></td>
<td>- Removal of excavation material</td>
</tr>
<tr>
<td>- 1173.2(2) 58 mm dia thick</td>
<td></td>
<td>The schedule quantity is a provisional quantity.</td>
</tr>
<tr>
<td>walled unplasticised PVC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pressure pipe.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- 1173.2(3) 65 mm dia slotted</td>
<td></td>
<td></td>
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<tr>
<td>corrugated plastic pipe.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1173.3 Cleanout structures</strong></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 11771 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.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 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:
AS 1289 Methods of testing soils for engineering purposes.
AS 1289.5.6.1-1998 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

| Item-Clause title | Requirement | Notice for inspection | Release by |
1174 Drainage mats

<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>Principal Certifying Authority</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>Principal Certifying Authority</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>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 Subsurface drainage.
- Type B mats: Type A or D filter material to Subsurface drainage.

3.2 GEOTEXTILE

General
Geotextile: To Subsurface drainage.

3.3 PVC PRESSURE PIPE

General
Thick walled unplasticised PVC pressure pipe: To 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:
- 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:
- 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><strong>Type A mats &amp; Type B mats</strong></td>
</tr>
<tr>
<td>Compaction (Relative)</td>
<td>100% (Standard compaction)</td>
<td><strong>Type B mats</strong></td>
</tr>
<tr>
<td>Type B mats</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design level at top of</td>
<td>+ 0, – 40 mm</td>
<td><strong>Type B mats</strong></td>
</tr>
<tr>
<td>mat</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 5 MEASUREMENT AND PAYMENT

#### 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>
</table>
| 1174.1 Supply and placement of geotextile | m² of area covered | All costs associated with:
- Area covered by geotextile measured on site, excluding additional geotextile used in lap joints.
- For Type A drainage mats, the additional layer of geotextile placed under rock facing.
- All costs associated with supply, placing and securing of the geotextile material.
- The schedule quantity is a provisional quantity. |
| 1174.2 Drainage mat outlet pipe        | -The linear metre of pipe laid Actual length laid will be measured along the centreline of the pipe including pipe leading to outlet structures. | All costs associated with:
- All costs associated with the supply and laying of the pipe.
- The schedule quantity is a provisional quantity. |
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 State or Local Government legislation.

Design
Authority requirements: This worksection does not override any applicable State 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 (or equivalent document in other states).

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS 1289 Methods of testing soils for engineering purposes
AS 1289.2.1.4-2005 Soil moisture content tests - Determination of the moisture content of a soil - Microwave-oven drying method (subsidiary method)
AS 1580 Paints and related materials—Methods of test
AS/NZS 1580.107.3-1997 Determination of wet film thickness by gauge
AS/NZS 1580.401.8-1997 No-pick-up time of road marking paints
AS 1742 Manual of uniform traffic control devices
AS 1742.2-2009 Traffic control devices for general use
AS 1742.3-2009 Traffic control devices for works on roads
AS 1906 Retroreflective materials and devices for road traffic control purposes
AS 1906.3-1992 Raised pavement markers (retroreflective and non–retroreflective)
AS/NZS 2009:2006 Glass beads for pavement-marking materials
AS 2700-2011 Colour Standards for general purposes
AS 4049 Paints and related materials—Pavement marking materials
AS 4049.1-2005 Solvent-borne paint - For use with surface applied glass beads
AS 4049.2-2005 Thermoplastic pavement marking materials - For use with surface applied glass beads
AS 4049.3-2005 Waterborne paint— For use with surface applied glass beads
ASTM D3335-2009 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
1.4 STANDARD

General
Pavement markings: To AS 1742.2.

1.5 INTERPRETATION

Abbreviations
General: For the purposes of this worksection the definitions given below apply:
- CAP: Two part cold applied plastic material.
- 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.

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.
Drawings: [complete/delete]
Calculations: [complete/delete]
- Components: Refer materials.
Design: [complete/delete]
Manuals: [complete/delete]
Prototypes: [complete/delete]
Samples: [complete/delete]
Warranties: [complete/delete]
- Technical data: Equipment suitability and application measurement as specified.
Type tests: [complete/delete]
Type test results: [complete/delete]
- 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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Establishment Surface preparation</td>
<td>Approval for surface preparation required</td>
<td>7 days before commencement of activity</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Establishment - Surface preparation</td>
<td>Superintendent direction on suspension of work</td>
<td>Progressive</td>
<td>Principal Certifying Authority</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>Principal Certifying Authority</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>Two part cold applied pavement marking – Field testing</td>
<td>Application of paint and beads to be checked for quality</td>
<td>Progressive</td>
</tr>
<tr>
<td>Pavement marking tape - Application</td>
<td>Direction to remove pavement marking tape</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 workssections/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 screeded 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 TWO PART COLD APPLIED PAVEMENT MARKING MATERIAL

Quality
Lead content: When determined by method ASTM D3335, the lead content must be no greater than 0.25 %.
No pick up time: Measured at 23°C and tested to AS 1580.401.8.
- For trowel or screed applied material (containing intermix glass beads), maximum 20 minutes for 2.0 ± 0.25 mm applied film thickness.
- For spray material (contains no glass beads), maximum 5 minutes for 0.200 ± 0.025 mm applied film thickness.
Luminance: White road marking material luminance factor as delivered must be not less than 75%.
Abrasion resistance: Loss in mass must not exceed 0.3 g for 500 cycles.
Sprayed material: Generally used for longitudinal line markings.
Trowelled, screeded, sprayed or extruded material: Generally used for transverse lines and other pavement markings.

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).

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>
</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/m\(^2\) 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/m\(^2\).

**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 TWO PART COLD APPLIED PAVEMENT MARKING

Apply primer: If the surface is concrete or is smooth or polished or where recommended by the manufacturer. Apply to the manufacturer’s recommendations.
Uniformly apply anti-skid material and glass beads onto the two part cold applied material while fluid and immediately after it has been applied to the pavement.
Separate bead applications: For longitudinal lines.
Method: Must ensure the retention of the beads in the material.
Application rate: As specified in the following table:

**Table Application rates – two part cold applied pavement materials and glass beads**

<table>
<thead>
<tr>
<th>Material</th>
<th>Longitudinal Linemarking</th>
<th>Transverse lines and other markings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sprayed application</td>
<td>Trowelled, screeded or extruded</td>
</tr>
<tr>
<td>Cold applied material thickness (excluding surface applied beads)</td>
<td>0.5 ± 0.05 mm (wet)</td>
<td>2.0 ± 0.2 mm (dry)</td>
</tr>
<tr>
<td>Completed marking thickness</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface applied glass beads *:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Type (AS/NZS 2009)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Rate retained in the painted surface</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type D-HR (adhesive coated) ≥ 400 g/m(^2)</td>
<td></td>
<td>Type B ≥ 300 g/m(^2)</td>
</tr>
<tr>
<td>1.0 – 2.0 mm anti-skid material</td>
<td>≥ 200 g/m(^2)</td>
<td></td>
</tr>
<tr>
<td>0.4-0.7 mm anti-skid material</td>
<td>≥ 200 g/m(^2)</td>
<td>≥ 200 g/m(^2)</td>
</tr>
</tbody>
</table>

---

* Glass beads must be coated with a compatible coupling agent to form an improved adhesive bond with thermoplastic or PMMA (two part cold applied) road marking material.

**Longitudinal lines**
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.

**Transverse lines**

Tolerances:
- Setting out: No more than 50 mm from the locations shown on the drawings.
- Widths: ± 10 mm.
- Lengths: ± 10 mm.

**Field testing**

Verify the thickness of the unbeaded material applied to the road pavement using Test Method RMS T841. This is a **WITNESS POINT**.

## 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. 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.

<table>
<thead>
<tr>
<th>Summary of limits and tolerances table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Activity</strong></td>
</tr>
<tr>
<td>Setting out</td>
</tr>
<tr>
<td>Longitudinal Lines</td>
</tr>
<tr>
<td>-Length</td>
</tr>
<tr>
<td>-Width</td>
</tr>
<tr>
<td>Transverse lines</td>
</tr>
<tr>
<td>-Length and width</td>
</tr>
<tr>
<td>Arrows, chevrons, painted medians, speed markings etc.</td>
</tr>
<tr>
<td>Application of paint</td>
</tr>
<tr>
<td>-Film thickness</td>
</tr>
<tr>
<td>Application of thermoplastic</td>
</tr>
<tr>
<td>-Longitudinal lines—Cold Film Thickness</td>
</tr>
<tr>
<td>-Transverse Lines, Symbols, Arrows etc. Cold film thickness</td>
</tr>
<tr>
<td>Glass beads</td>
</tr>
<tr>
<td>-Volume used in operation</td>
</tr>
<tr>
<td>-CAP</td>
</tr>
</tbody>
</table>
5 MEASUREMENT AND PAYMENT

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 beads and traffic control.</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></td>
</tr>
<tr>
<td>1191.2 Pavement marking paint—Transverse lines, symbols, legends, arrows, chevrons, traffic islands and kerbs</td>
<td>Linear metres</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>- 1191.2(1) Transverse lines</td>
<td>Each</td>
<td></td>
</tr>
<tr>
<td>- 1191.2(2) Arrow</td>
<td>Each</td>
<td></td>
</tr>
<tr>
<td>- 1191.2(3) Symbols</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>- 1191.2(4) Chevrons</td>
<td>m</td>
<td></td>
</tr>
<tr>
<td>- 1191.2(5) Kerbs</td>
<td>m²</td>
<td></td>
</tr>
<tr>
<td>- 1191.2(6) Traffic Islands</td>
<td>Each or m²</td>
<td></td>
</tr>
<tr>
<td>- 1191.2(7) Legends</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1191.3 Thermoplastic (or cold Applied Plastics) pavement marking material—Longitudinal lines</td>
<td>Line pattern km (including any gaps)</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></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></td>
</tr>
<tr>
<td>1191.4 Thermoplastic (or cold Applied Plastics) pavement marking material - transverse lines, symbols, legends and arrows</td>
<td>Linear metres</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>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
<td>---------------------</td>
</tr>
</tbody>
</table>
| -1191.4(6) Traffic Islands  
-1191.4(7) Legends | m²  
Each or m² | |
| **1191.5 Raised pavement markers (all applications)** | ‘Each’ raised pavement marker installed | All costs associated with the setting out of the work, supply and installation of all material and provision for traffic. |
| **1191.6 Removal of pavement markings** | m² | All costs associated with removal and disposal. |

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/m$^2$: 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/m$^2$ for different line widths and road speeds.

Volume required for 0.30 kg/m$^2$: 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/m$^2$. 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/m$^2$: 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/m$^2$.

### 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>
<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></td>
<td>396</td>
<td>495</td>
<td>594</td>
<td>742</td>
<td>990</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>643</td>
<td>804</td>
<td>965</td>
<td>1207</td>
<td>1698</td>
</tr>
<tr>
<td>16</td>
<td></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 be checked separately to make up the totals shown.
3. Glass beads weigh approximately 1.53 g/ml.
1192 SIGNPOSTING

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.

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1101 Control of traffic.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
- AS 1214-1983 Hot-dip galvanized coatings on threaded fasteners (ISO metric coarse thread series).
- AS/NZS 1554 Structural steel welding.
- AS 1580 Paints and related materials—Methods of test.
- AS 1580.108.2: 2004 Dry film thickness—Paint inspection gauge.
- AS 1627 Metal finishing – Preparation and pre-treatment of surface
- AS 1627.1: 2003 Removal of oil, grease and related contamination
- AS 1627.4: 2005 Abrasive blast cleaning of steel
- AS 1627.9: 2002 Pictorial surface preparation standards for painting steel surfaces
- AS 1742 Manual of uniform traffic control devices.
- AS 1742.4-2008 Speed controls
- AS 1742.5-1997 Street name and community facility name signs
- AS 1743-2001 Road signs—Specifications.
- AS 1744-1975 Forms of letters and numerals for road signs.
- AS/NZS 3679 Structural steel.
- AS/NZS 3679.1:2010 Hot-rolled bars and sections.
- AS 4100-1998 Steel structures.
- AS/NZS 4680: 2006 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.
AS/NZS 4819: 2011 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.

Drawings: [complete/delete]
Design: [complete/delete]
Calculations: [complete/delete]
Manuals: [complete/delete]
Samples: [complete/delete]
Prototypes: [complete/delete]
Technical data: [complete/delete]
Evidence of type tests: [complete/delete]
Warranties: [complete/delete]

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>Details of manufacturer materials and attachment systems</td>
<td>1 week prior to commencement of manufacture</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Approval</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulatory, warning and guide signs</td>
<td>Evidence that materials and parts proposed comply with worksection requirements</td>
<td>1 week prior to engaging supplier</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
<td></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>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
</tbody>
</table>
### Clause/subclause | Requirement | Notice for inspection | Release by
---|---|---|---
**Attachment of signs**<p>Details of proposed attachment systems | 2 weeks prior to fabricating attachment systems | Principal Certifying Authority

**Footing reinforcement**

**Steel reinforcement cages**<p>Evidence of material conformity | 1 week prior to fabrication | Principal Certifying Authority

**Off-site requirements**

**Inspection**<p>Notice of availability of sign structures for inspection | 2 working days | Principal Certifying Authority

**Establishment**

**Existing underground services**<p>Locate services and protect against damage | 1 week prior to erection | Principal Certifying Authority

**Location**<p>Details of set-out | 1 week prior to erection | Principal Certifying Authority

### WITNESS POINTS table – On site activities

| Clause/subclause | Requirement | Notice for inspection |
---|---|---|
**Footing reinforcement**

**Steel reinforcement cages**<p>Splicing location and method | 3 working days before splicing bars

**Clearing**

**General**<p>Clear vegetation after set-out on advice from Council’s Tree Preservation Officer | 3 working days before clearing

**Sign structure footings**

**Excavation**<p>Excavation as shown on drawings and as directed, including disposal of material | 1 working day before next activity

**Erection**

**Sign damage**<p>Repair or replace damaged signs | 1 week before installing signs

**Adjustment of existing signs and support structures**

**General**<p>Conform to Drawings and Superintendent direction | 1 week before adjusting signs

---

## 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.
- Incorporate the Council’s logo, as supplied by the Superintendent.

Proprietary sign requirements
Manufacture and installation: To the requirements of AS 1742.5 Street Name and Community Facility Name Signs, to the following details:
[complete/delete]

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 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 galvanized 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 worksection 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 Preservation 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: 12 months following the date of dispatch from the Contractor’s Works to the Site.
Failed or defective structures: Obligations:
- Remove any sign structure which has failed in service or found defective within 12 months of the date of dispatch.
- 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.
Application: This warranty to apply notwithstanding any defects liability period provided for in the General Conditions of Contract.

4.8 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>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>Activity</td>
<td>Limits/Tolerances</td>
<td>Worksection Clause Reference</td>
</tr>
<tr>
<td>----------</td>
<td>------------------</td>
<td>-----------------------------</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>
</tr>
<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>
</tr>
<tr>
<td>Paint coating over Splices in standard galvanised posts</td>
<td>&gt; 100 microns</td>
<td>Sign structures and anchor bolt assemblies</td>
</tr>
<tr>
<td>Damaged surface of galvanised surfaces:</td>
<td></td>
<td></td>
</tr>
<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>
<td></td>
<td></td>
</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>
<td></td>
<td></td>
</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

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>Pay items</td>
<td>Unit of measurement</td>
<td>Schedule rate scope</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>--------------------------------------</td>
<td>-------------------------------------------------------------------------------------</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 galvanized 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-designed)</td>
<td>Each sign support structure. Note: Where a purpose-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>All costs of fabrication, hot-dip galvanising, fittings, packaging, storage for up to 2 months and delivery free on truck.</td>
</tr>
<tr>
<td>1192.6 Supply and delivery of anchor bolt assemblies</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>1192.6(1) Mk 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1192.6(2) Mk 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1192.6(3) Mk 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1192.6(etc) etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1192.7 Supply and delivery of reinforcement cages</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>1192.7(1) (Size)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1192.7(2) (Size)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1192.7(3) (Size)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1192.7(etc) etc</td>
<td></td>
<td></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</td>
<td>The total face surface area of the signs adjusted. All costs of dismantling of signs and sign structure, relocation or</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>signs and sign support structures and to cover all work required that is not covered by the other pay items under signposting.</td>
<td>replacement of sign structures including excavation, concrete 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: [complete/delete]
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 1101 Control of traffic.
- [complete/delete]

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS 1604.1-2010 Sawn and round timber.
AS 1742 Manual of uniform traffic control devices
AS 1742.2-2009 Traffic control devices for general use
AS/NZS 1906 Retroreflective materials and devices for road traffic control purposes.
AS 3730 Guide to the properties of paints for buildings.

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.
- Guide post: Posts used to mark the edge of the road carriageway. They assist the road user by indicating the alignment of the road ahead, especially at horizontal and vertical curves and under some circumstances, by providing a gauge with which to assess available sight distance.
- Rigid guide post: A guide post which either fails by fracturing or remains intact and straight, but not vertical, when impacted by a vehicle.
- Semi-flexible guide post: A guide post which fails by bending when impacted by a vehicle and can be straightened with maintenance intervention.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.

Documents
Requirement: Submit the following for approval:
- Materials:
  - Natural durability class and grade of timber posts.
  - Technical specifications and certificates of proprietary non-timber posts.
- Drawings: Set out for post locations.
- Execution details: Refer to WITNESS POINTS – On-site activities.

Design: [complete/delete]
Calculations: [complete/delete]
Manuscripts: [complete/delete]
Samples: [complete/delete]
Evidence of type tests: [complete/delete]
Warranties: [complete/delete]

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>Principal Certifying Authority</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>Principal Certifying Authority</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>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Installation of guide posts – Proprietary guideposts</td>
<td>Provide manufacturers anchorage instructions</td>
<td>5 working days</td>
<td>Principal Certifying Authority</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>MATERIAL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timber posts - Finish</td>
<td>Timber treatment inspection</td>
<td>1 working day - progressive</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clause/ subclause</td>
<td>Requirement</td>
<td>Notice for inspection</td>
</tr>
<tr>
<td>---------------------------</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 guide post including the following:
- Type of material.
- 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 gloss or semi-gloss opaque white. 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: One face of 100 ± 5 mm.
Thickness: 50 ± 5 mm.

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: Semi-flexible and 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**
Top cap: Guide posts manufactured from thin walled hollow sections or sheet material of less than 10 mm thickness must each be fitted with a cap on the top of the guide post.
Dimensions: Caps must cover the whole top of the guide post with minimum dimensions 100 mm by 25 mm.
Type: The cap must be the same colour and durability as the guide post and be rounded with no sharp edges.
Attachment: Cap must be attached so that it cannot be dislodged from the guide post by a force of 500N pulling on the cap in a direction away from the post.
Plastic: The tops of guide posts manufactured from plastic must incorporate rounded edges and corners.

### 3.2 TIMBER POSTS

**Description**
General: Conform to the following:
- All surfaces: Smooth and free from obvious saw marks.
- Dimensions: 90 x 45 mm finished size x 1400 mm long.
- Post top: Slope the 90 mm face 10 mm off-square.
Natural durability class of the species supplied: To AS 5604.
Preservation treatment: Hazard class H4 to AS 1604.1 Table 1 to the following extent:
- Natural durability class 1 or 2 with less than 20% sapwood cross section: No treatment.
- Natural durability class 1 or 2 with more than 20% sapwood cross section: Full treatment.
- Natural durability class 3 or 4: Full treatment.
Grade: Structural grade No.4 to AS 2082.

**Softwood**
Preservation treatment: Hazard class H4 to AS 1604.1 Table 1.
Grade: Structural grade No.5 to AS 2858.

**Finish**
Preparation: Stop holes, cracks and other imperfections with white putty after the primer coat.
Paint:
- Primer:
  - Wood primer, latex, one coat: To AS 3730.17. If posts are preservative treated, apply a first coat of solvent-borne primer followed by the latex primer.
- Undercoat:
  - Undercoat, latex exterior, one coat: To AS 3730.18.
- Top coat:
  - Gloss latex exterior, one coat: To AS 3730.10.

This is a WITNESS POINT.
Application: To AS 2311 Section 6.
Colour: White.

### 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 retroflective 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 vandalism 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 or semi-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 guide 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:
  . Rigid and timber guide posts: 500 mm.
  . Flexible and semi-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.

Backfilling
General: Backfill guide posts firm in the ground as follows:
- Compact in layers not more than 150 mm for the full depth of the guide posts up to ground level.
- Density of the compacted backfilling: Not less than that of the adjacent undisturbed ground.

This is a WITNESS POINT.

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
Timber posts: Attach ‘Corner Cubed’ delineators to each guide post using one way, anti-theft screws.
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

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>
1194 NON-RIGID ROAD SAFETY BARRIER SYSTEMS

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).

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1163 Rigid road safety barrier systems.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS 1214-1983 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 1237.1-2002 General plan
AS 1237.2-2002 Tolerances
AS/NZS1594:2002 Hot-rolled steel flat products
AS 1627 Metal finishing – Preparation and pre-treatment of surfaces
AS1627.4-2005 Abrasive cleaning of steel
AS1627.5-2003 Pickling
AS/NZS 1906 Retroreflective materials and devices for road traffic control purposes
AS/NZS 1906.2:2007 Retroreflective devices (Non pavement application)
AS 2858-2008 Timber–softwood – visually stress-graded for structural purposes
AS 2311-2009 Guide to the painting of buildings
AS 3730 Guide to the properties of paints for buildings
AS 3730.10-2006 Latex – Exterior – Gloss
AS 3730.18-2006 Undercoat / Sealer – Latex - Interior
AS/NZS 3845:1999 Road safety barrier systems
AS/NZS 4680:2006 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 worksection the abbreviations given below apply:
- MELT: Modified eccentric loader terminal.

Definitions
General: For the purposes of this worksection 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. In 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.
- Thrie-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 thrie-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.

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.
  - Timber.
  - Wire rope safety barrier systems.
  - Plastic.
- Manuals: Installation and maintenance manuals for all proprietary barrier and end treatment systems used in the works.

Design: [complete/delete]
Proprietary items: [complete/delete]
Samples: [complete/delete]
Prototypes: [complete/delete]
Technical data: [complete/delete]
Evidence of type tests: [complete/delete]
Warranties: [complete/delete]

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>Steel</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Protective treatment</td>
<td>Provide manufacturers certificate of compliance for</td>
<td>1 week prior to erection</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Timber</td>
<td>1194 Non-rigid road safety barrier systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Certificates of compliance</strong></td>
<td>Provide documentary evidence of conformity of timber components</td>
<td>1 week prior to erection</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Wire rope safety barrier systems</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Proprietary item</strong></td>
<td>Submit compliance certification</td>
<td>1 week prior to erection</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Existing underground services</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Locate services underground</td>
<td>5 working days prior to erection</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Establishment</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Method statement</strong></td>
<td>Process description for the installation of road safety barrier systems</td>
<td>1 week prior to erection</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Location of barriers</strong></td>
<td>Set out to drawings or as directed</td>
<td>2 working days prior to erection</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>End treatment of road safety barriers</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>MELT</strong></td>
<td>Submit alternative MELT locations</td>
<td>1 week prior to ordering</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Installation of wire rope safety barrier systems</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Manufacturers published requirements</strong></td>
<td>Submit tension certificates and testing</td>
<td>Same day as tensioning</td>
<td>Principal Certifying Authority</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><strong>Establishment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sequence of construction</strong></td>
<td>Erection after pavement activities</td>
<td>1 week before installation – progressive</td>
</tr>
<tr>
<td><strong>Alternative method of setting posts</strong></td>
<td>Alternative method due to obstructions</td>
<td>1 week before setting posts</td>
</tr>
<tr>
<td><strong>Erection of steel posts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Driving equipment</strong></td>
<td>Equipment and procedure for erection</td>
<td>1 week before installation</td>
</tr>
<tr>
<td><strong>Damage to posts</strong></td>
<td>Assessment by Superintendent for replacement</td>
<td>3 working days before removal of damaged post</td>
</tr>
<tr>
<td><strong>Erection of road safety barrier systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Excessive damage to rails</strong></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: 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, blockout 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 TIMBER
Certificates of compliance
Certificates of compliance: Do not erect timber road safety barrier components until the Contractor has produced documentary evidence that the timber components conform to this worksection. This is a HOLD POINT.
Quality
Location: Use timber posts only in W-beam terminal sections, as shown on the drawings.
Standard: Type, grade, size and treatment level to conform with AS/NZS 3845.
Quality: All surfaces smooth and free from obvious saw marks.
Storage: Do not store any timber posts/blockout blocks on top of the steel sections.
Finish
Preparation: Stop holes, cracks and other imperfections with white putty after the primer coat.
Paint: Conform to the following:
- Undercoat: Undercoat, latex exterior, one coat: To AS 3730.18.
- Top coat: Gloss latex exterior, one coat: To AS 3730.10.
Application: To AS 2311 Section 6.
1194 Non-rigid road safety barrier systems

Colour: Grey.

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 ERECTION OF TIMBER 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 with 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.

Polystyrene foam
Wrap posts: Wrap the section of the timber posts to be cast into a reinforced concrete footing in 12 mm thick polystyrene foam sheeting before concrete casting.

Concrete Footings
Minimum compressive strength: 32 MPa at 28 days to conform with 0319 Minor concrete works.
Footing size: 600 mm diameter to AS/NZS 3845.
Tolerance of footing: - 0 to + 50 mm depth.
Overbreak: Fill over-excavation and excessive depth with 32 MPa concrete at no cost to the Principal.

Reinforcing fabric
Specification: Wire fabric reinforcing as shown on the drawings.

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 HANDBOVER 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. If timber posts are used, detail the timber species and stress grade.

4.12 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/ subclause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical alignment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tops of steel posts.</td>
<td>± 20 mm</td>
<td>Erection of steel posts</td>
</tr>
<tr>
<td>Tops of timber posts</td>
<td>± 20 mm</td>
<td>Erection of timber posts</td>
</tr>
<tr>
<td>Post movement</td>
<td>≤ 3 mm</td>
<td>Erection of steel posts</td>
</tr>
<tr>
<td>Concrete footings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td>0 to 50 mm</td>
<td>Erection of timber posts</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

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><strong>1194.1 Single sided road safety barrier</strong></td>
<td>Linear metre.</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>- 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></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(5) Single Modified Blockout 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><strong>1194.2 Modified eccentric loader terminal (MELT)</strong></td>
<td>Each</td>
<td>All costs associated with supply and erection of MELTS as detailed on the drawings.</td>
</tr>
<tr>
<td>- 1194.2(1) Leading Terminal</td>
<td>- Each MELT section supplied and erected</td>
<td></td>
</tr>
<tr>
<td>- 1194.2(2) Trailing Terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1194.3 Terminal section</strong></td>
<td>Each</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>- Each terminal section supplied and erected</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</td>
<td>All costs associated with supply and erection of RSB connectors as detailed on the drawings excluding the anchorage assemblies cast into the rigid road safety barrier or bridge parapet.</td>
</tr>
<tr>
<td>- 1194.4(1) W-beam to RSB</td>
<td>- Each connector supplied and erected</td>
<td></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><strong>1194.5 Delineator brackets</strong></td>
<td>Each</td>
<td>All costs associated with s &amp; e delineator brackets.</td>
</tr>
<tr>
<td><strong>1194 6Double sided road safety barrier</strong></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>- The distance measured along the centre line of the rails, centre to centre of posts, excluding terminal sections and connectors to rigid safety barriers or bridge parapets.</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></td>
<td></td>
</tr>
<tr>
<td>- 1194.6(8) Nested W-Thrie-beam Transition</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1194.7 Double sided road safety barrier terminal section</strong></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>
1195 BOUNDARY FENCES FOR ROAD RESERVES

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: [complete/delete]

Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 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:
AS 1074 – 1989 Steel tubes and tubulars for ordinary service.
AS 1111 ISO Metric hexagon bolts and screws – Product grade C.
AS 1111.1 – 2000 Bolts.
AS 1111.2 – 2000 Screws.
AS 1112 – Various ISO Metric hexagon nuts.
AS 1237 Plain washers for metric bolts, screws and nuts for general purposes.
AS 1237.1 – 2002 General plan.
AS 1237.2 – 2002 Tolerances.
AS 1289 Methods of testing soils for engineering purposes.
AS 1289.5.6.1 – 1998 Soil compaction and density tests - Compaction control test - Density index method for a cohesionless material.
AS/NZS 1390 – 1997 Cup head bolts with ISO metric coarse pitch threads.
AS 1720 – various Timber structures.
AS 1725 Chain-link fabric security fencing and gates.
AS 1725.2 – 2010 Tennis court fencing – Commercial.
AS 1725.4 – 2010 Cricket net fencing enclosures.
AS 1725.5 – 2010 Sports ground fencing – General requirements.
AS 1742 Manual of uniform traffic control devices.
AS 1742.2 – 2009 Traffic control devices for general use.
AS 2423 – 2002 Coated steel wire fencing products for terrestrial, aquatic and general use.
AS 3600 – 2009 Concrete structures.
AS/NZS 4680 – 2006 Hot-dip galvanised (zinc) coatings on fabricated ferrous articles.
AS/NZS 4792 – 2006 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
Calculations: [complete/delete]
Execution: Written approval for access to properties.
Materials: Posts, wire products, concrete, timber, gates.
Prototypes: [complete/delete]
Samples: [complete/delete]
Technical data: [complete/delete]
- Certificates of compliance.
Type tests: [complete/delete]
Warranties: [complete/delete]

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>Principal Certifying Authority</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>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>- Temporary fencing</td>
<td>Maintain rabbit-proof fence at night and weekends</td>
<td>During works</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>- Removal and disposal of surplus</td>
<td>Approval required for burn off for combustible</td>
<td>Prior to burning</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>
### Erection of posts

<table>
<thead>
<tr>
<th>- Clearing and grubbing</th>
<th>Confirm approval for tree removal</th>
<th>One week before next activity</th>
<th>Principal Certifying Authority</th>
</tr>
</thead>
<tbody>
<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>Principal Certifying Authority</td>
</tr>
<tr>
<td>- Depth of posts</td>
<td>Method of installing and proposed type of posts to be used</td>
<td>One week before manufacture or order</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Erection of wires - General</td>
<td>Approval for any proprietary fasteners</td>
<td>One week before manufacture or order</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Flood gates - general</td>
<td>Approval to proceed with flood gates and type</td>
<td>One week before fabricating flood gates</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Stock grids - General</td>
<td>Approval for type and location of grid</td>
<td>One week before fabricating flood gate</td>
<td>Principal Certifying Authority</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><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steel posts - Fence posts</td>
<td>Welding sites to be cleaned and painted</td>
<td>Progressive</td>
</tr>
<tr>
<td>Steel posts - Strainer posts / Intermediate posts</td>
<td>Dimension alternatives</td>
<td>3 working days before commencing works</td>
</tr>
<tr>
<td>Gates - General</td>
<td>Fitting alternatives</td>
<td>3 working days before fabrication</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Establishment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- General</td>
<td>Take precautions against damage and injury to animals or persons</td>
<td>Progressive</td>
</tr>
<tr>
<td>- Removal of existing fencing</td>
<td>Approval to cut posts in rock off at ground level</td>
<td>Before removing fence</td>
</tr>
<tr>
<td>- Removal and disposal of surplus material and rubbish</td>
<td>All surplus material to be removed</td>
<td>Progressive</td>
</tr>
<tr>
<td>- Clearing and grubbing</td>
<td>Vary fencing to avoid tree removal</td>
<td>One week before activity</td>
</tr>
<tr>
<td>- Connections to existing fences</td>
<td>Submit detail of proposed connection</td>
<td>One week before making connection</td>
</tr>
<tr>
<td>Erection of posts – Depth of posts</td>
<td>Check diameter of posts</td>
<td>One week before activity</td>
</tr>
<tr>
<td>Gates - Erection</td>
<td>Double gates to be directed</td>
<td>One week before ordering</td>
</tr>
<tr>
<td>Flood gates – Small water courses</td>
<td>Prevent erosion</td>
<td>Progressive</td>
</tr>
</tbody>
</table>
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 2858 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: [complete/delete]

**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 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 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. Seek direction from Superintendent to supply temporary fencing. This is a HOLD POINT.
Rabbit-proof fence: Ensure that at night, weekends or other times when work is not being carried out, the whole of the fence is maintained in a rabbit-proof condition. Seek direction from Superintendent to supply temporary fencing. 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 without prior approval. If permitted, burn in conformance with local legislation. The Contractor is responsible for any damage which may result from the lighting of fires associated with the work. Do not burn any pre treated timber. This is a HOLD POINT.

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 0136 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**.

#### Posts depth table

<table>
<thead>
<tr>
<th>Type of post</th>
<th>Depth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Earth</td>
</tr>
<tr>
<td>Concrete strainer posts</td>
<td>900</td>
</tr>
<tr>
<td>Concrete intermediate posts</td>
<td>600</td>
</tr>
<tr>
<td>Treated timber strainer posts</td>
<td>900</td>
</tr>
<tr>
<td>Treated timber intermediate posts</td>
<td>600</td>
</tr>
<tr>
<td>Galvanised steel strainer posts</td>
<td>900</td>
</tr>
<tr>
<td>Galvanised steel intermediate posts</td>
<td>600</td>
</tr>
<tr>
<td>Other steel posts</td>
<td>450</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.

Rabbit-proof fencing
Erect: As for netting and as shown on drawings.
Netting position: Erect wire netting on the side of the fence remote from the roadway in the case of road reserve boundary fences. In other cases, erect the netting as directed.
Fixing of netting: Fix netting with approved tie wire or fixing clips.
Straining and tying: Loosely tie the netting to fence wires then carefully strain without disturbing or breaking the mesh, and then tie to the wires immediately on each side of the post and at intervals not exceeding 1 m.
Bottom section: Bury, or lay flat on the ground, the bottom section of the netting as shown on the drawings.
Burying: If burying the net, excavate the trench prior to running the netting out.
Lap/Trench: Erect the netting so there is a 200 mm lap laid on the ground surface, or trenched 215 mm into the ground as shown on the drawings for the type of fence erected.
Strainer posts: At each strainer post brace attach additional netting adjacent to the strainer post to a height of the top wire 450 mm wide from the post as shown on the drawings.

4.6 GATES

Erection
Swing: Erect gates so that they swing away from the road.
Single gates: Supply single gates unless other wise 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 FLOOD GATES

General
Waters: Make suitable provision for the passage of flood waters past the fence at all watercourses. Provide flood gates of the type indicated on the drawings, or as directed. This is a HOLD POINT.
Prevent: Erect flood gates to prevent the accumulation of flood debris, while remaining stock-proof or rabbit-proof.

Small watercourses
Type: Provide flap gate and support frame as shown on drawings or as directed.
Opening: Waterway area at least twice that of the culvert opposite to which it is placed, or as otherwise directed.
Width: < 3.0 m.
Construction detail: Provide a flap of hardwood frame with lapped corner joints each secured by two M6 galvanized bolts. Cover the frame with a 1 mm galvanised sheet secured to the frame by 25 x 2.8 mm galvanised clouts at 100 mm maximum centres. Swing the flap from a hardwood rail
connected to the strainer posts located on each edge of the gully or creek with M12 galvanised
cup head bolts.
Erosion: Protect the lower edge of the opening from the effects of erosion of the creek bed by
installing hardwood sheeting to a minimum depth of 300 mm below the existing ground level and
as shown on the drawings. This is a WITNESS POINT.

**Gullies and creeks**
Location: Provide flood gates in gullies and creeks at the locations indicated on the drawings, or
as directed.
Construction detail: Suspend a 9 mm galvanised steel wire rope over the gully in one span, thread
through a strainer post on each edge of the gully and tie back to an anchor set in the footing of
each adjacent intermediate post. Provide end connections incorporating a thimble and wire rope
grips. Provide turnbuckles at each end to tension the wire rope so that it lays horizontally.
Suspend netting from the wire rope, fixed at 200 mm intervals, overlap and tie securely. Provide
netting with sufficient length to lie on the ground for a distance of not less than 1.0 m on the
downstream side.
Netting ballast: 150 mm diameter treated timber securely fixed to the netting with 25 mm
galvanised staples at the downstream end of the netting.
Trim: Trim the sides of the gully, as necessary, to ensure that the flood gate is stock-proof or
rabbit-proof.
Flow: Make sure the flood gate has sufficient movement of the suspended portion under the flow
of flood waters to prevent damage to the fence and the accumulation of debris against it.
Stay: Each strainer post in three directions, as shown on the drawings.

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 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>Steel posts</td>
<td>Type: Medium quality</td>
<td>Materials – Steel posts</td>
</tr>
<tr>
<td></td>
<td>Star posts: Weight of 290 posts 1.65 m long &gt; 1 tonne</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pipe rail: Diameter nominal = 32 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strainer posts: Diameter = 150 mm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wall thickness &gt; 4 mm</td>
<td></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>Activity</td>
<td>Limits/Tolerances</td>
<td>Worksection Clause Reference</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------</td>
<td>---------------------------------------</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</td>
<td>Materials – Prestressed concrete posts</td>
</tr>
<tr>
<td></td>
<td>Concrete strength &gt; 32 MPa at 28 days</td>
<td></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</td>
<td>Erection of posts</td>
</tr>
<tr>
<td></td>
<td>Except for cattle retention &lt; 90 m</td>
<td></td>
</tr>
<tr>
<td>Wires</td>
<td>Table for wire tensions</td>
<td>Erection of wires</td>
</tr>
<tr>
<td>Flood gates</td>
<td>For small watercourses width &lt; 3.0 m</td>
<td>Flood gates</td>
</tr>
</tbody>
</table>

5 MEASUREMENT AND PAYMENT

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 (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>
</tr>
<tr>
<td>1195.2 Supply &amp; erection of boundary fence gates</td>
<td>‘Each’ gate erected</td>
<td>All costs associated with the supply of all material and all activities associated with the erection of each gate.</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>

1351 STORMWATER DRAINAGE (CONSTRUCTION)

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:** [complete/delete]

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).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 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 channel (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:

- **AS 1141** Methods for sampling and testing aggregates
- **AS 1141.11.1-2009** Particle size distribution - Sieving method
- **AS 1289** Methods of testing soils for engineering purposes
- **AS 1289.3.2.1-2009** Soil classification tests - Determination of the plastic limit of a soil - Standard method
- **AS 1289.3.3.1-2009** Soil classification tests - Calculation of the plasticity index of a soil
- **AS 1289 4.3.1-1997** Soil chemical tests - Determination of the pH value of a soil - Electrometric method
- **AS 1289 4.4.1-1997** Soil chemical tests - Determination of the electrical resistivity of a soil - Method for sands and granular materials
- **AS 1289.5.4.1-2007** Soil compaction and density tests—Compaction control test—Dry density ratio, moisture variation and moisture ratio
- **AS 1289.5.7.1-2006** 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 2566.1:1998** Structural design - Commentary
- **AS/NZS 2566.2:2002** Installation
- **AS 3000-2009** Concrete structures
- **AS/NZS 3725:2007** Design for installation of buried concrete pipes
- **AS/NZS 3725 Supp 1:2007** Loads on buried concrete pipes - Commentary (Supplement to AS/NZS 3725:2007)
- **AS 3735-2001** Concrete structures retaining liquids

**Other publications**

- **Institute of Public Works Engineering Australia (IPWEA)**
- **IPWEA (NSW)-2010** Specification for the supply of recycled materials for pavements, earthworks and drainage (Greenspec)
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.

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.

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.

Design: [complete/delete]
Manuals: [complete/delete]
Prototypes: [complete/delete]
Evidence of type tests: [complete/delete]
Warranties: [complete/delete]

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.

PRE-CONSTRUCTION PLANNING

<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>Authority Approvals</td>
<td>Temporary drainage</td>
<td>Submit details of procedures/devices for approval</td>
<td>2 weeks prior to site commencement</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>
<td>-----------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td><strong>MATERIALS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bedding, support and backfill material</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Durability</strong> - Geotechnical NATA test</td>
<td>Submit tests for pH and resistivity</td>
<td>1 week prior to proceeding</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Durability</strong> - Test for concentration of impurities</td>
<td>Test for chloride, sulphate and aggressive CO₂</td>
<td>1 week prior to proceeding</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Establishment</strong></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>Principal Certifying Authority</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>Principal Certifying Authority</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Excavation near underground services - Contact DIAL 1100 BEFORE YOU DIG</td>
<td>Contact DIAL BEFORE YOU DIG</td>
<td>1 week prior to proceeding</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Excavation near underground services - Marking</td>
<td>Submit marking for approval</td>
<td>1 week prior to proceeding</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Construction traffic - Protection measures</td>
<td>Submit certification and verification of protection measures</td>
<td>3 working days</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Excavation for drainage systems</strong></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>Principal Certifying Authority</td>
</tr>
</tbody>
</table>
Bedding and backfilling

| Uncompacted bedding for steel pipes and pipe arches | Submit details for achieving dense bedding zone | 1 week | Principal Certifying Authority |

Water sensitive urban design

| Landscape and vegetation - Plant species selection | Submit plant selection for a particular area | 1 week | Principal Certifying Authority |

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 pipes</td>
<td>Clear widths between structure and wall of excavation</td>
<td>3 working days</td>
</tr>
<tr>
<td>Inadequate foundation material - Notice</td>
<td>Identify unsuitable material and provide remedial measures</td>
<td>3 working days</td>
</tr>
<tr>
<td>Inadequate foundation material - Rock foundation</td>
<td>Additional excavation and backfill required if rock is encountered at foundation level</td>
<td>1 week</td>
</tr>
<tr>
<td>Bedding and backfilling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Backfilling – In situ concrete structures</td>
<td>Do not backfill against in situ concrete structures within 14 days of concrete placement</td>
<td>2 working days</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 drainage structures</td>
<td>Rectify any damage</td>
<td>2 working days before proceeding</td>
</tr>
<tr>
<td>Additional requirements for compaction of pipe drainage bedding</td>
<td>Provide if erosion of bedding material may occur</td>
<td>1 week</td>
</tr>
</tbody>
</table>

**Water sensitive urban design**

| Protection – Buffer strips, swales and bioretention systems | Provide temporary protection from construction traffic | 3 working days |
| Protection – Permanent protection | Provide permanent protection from vehicular traffic | 1 week |

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. For recycled crushed glass fines, gradation of material must meet Table 6 of AS3725
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 embankment method, provide embankment 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 channel (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.

Side zones of pipe trenches: Density and stiffness requirements to AS/NZS 3725 clause 9.2.3.1 for Type H2 support.
Embankment 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 H2 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.

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 100 for D \leq 1500 0.25 D but &gt;100 100 for D \leq 1500 150 for D &gt; 1500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>y</td>
<td>—</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>
</tr>
<tr>
<td>z</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>\geq 0.7D</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D = External diameter of pipe
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**

www.ipwea.org.au/newsouthwales/nswroadsdirectorategreenspec/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**.

**Bedding material compaction requirements table**

<table>
<thead>
<tr>
<th>Bedding material compaction requirements table</th>
<th>Pipe support type</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Criteria</strong></td>
<td><strong>Location</strong></td>
</tr>
</tbody>
</table>

© NATSPEC
### Bedding material

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Location</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>Minimum Relative Compactation %</td>
<td>Bed and haunch zones</td>
<td></td>
<td>50</td>
<td>60</td>
<td></td>
<td>50</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>AS1289.5.4.1 (Standard Compaction)</td>
<td>Side and overlay zones:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td>60</td>
<td>70</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.

**H2** 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 **H2** 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**

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:** [complete/delete]

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: [complete/delete]

4.8 COMPLETION

Inspection
Closed circuit television (CCTV) inspections: The contractor shall carry out closed-circuit television (CCTV) inspections of all drainage structures no more than fourteen (14) days prior to the completion of the project, to verify that the works are within the specified tolerances, the flow of water is not obstructed by surplus construction material and to check for visible signs of defects.

The contractor is to notify the superintendent of any impending CCTV inspections no less than twenty four (24) hours prior to the CCTV inspection being carried out.

On completion of the inspections the contractor shall submit to the Superintendent CCTV video footage and report of these inspections and any nonconformity detected, including video evidence of both the invert and obvert of pipes and box culverts with small openings. CCTV video footage and report is to be provided on all joints in a curved drainage line. The inspection and reporting must be in accordance with the current edition of WSA 05.

It may be in the interests of the contractor to undertake preliminary CCTV inspections on completion of the sub-base layer but prior to the construction of the kerb and guttering, to check for visible signs of defects. Any construction faults can be rectified at this stage at much lower cost than if detected on completion of the project.

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>
<tr>
<td>Excavation for drainage</td>
<td></td>
<td>Excavation and drainage</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>structures other than pipes</td>
<td></td>
<td>systems</td>
</tr>
<tr>
<td>- Clear width between wall of structure and face of excavation</td>
<td>The greater of 300 mm and 1/3 the face of excavation height</td>
<td></td>
</tr>
<tr>
<td>Uncompacted bedding and backfill</td>
<td>Minimum 75 mm thick</td>
<td>Bedding and backfilling</td>
</tr>
<tr>
<td>Maximum permitted distortion of pipes and pipe arches</td>
<td>± 2% from manufacturers specified dimensions</td>
<td></td>
</tr>
<tr>
<td>Minimum thickness of compacted layer</td>
<td>150 mm</td>
<td>Compaction</td>
</tr>
<tr>
<td>Maximum width of vegetated swales and buffer strips</td>
<td>2.5 m</td>
<td>Water sensitive urban design</td>
</tr>
<tr>
<td>Bioretention systems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Depth of filter media</td>
<td>0.3 – 0.7 mm</td>
<td></td>
</tr>
<tr>
<td>- Saturated conductivity</td>
<td>200 – 500 mm/hr</td>
<td></td>
</tr>
<tr>
<td>- Depth of drainage layer</td>
<td>100 – 200 mm</td>
<td></td>
</tr>
<tr>
<td>- Transition layer of sand or geotextile fabric</td>
<td>100 mm</td>
<td></td>
</tr>
<tr>
<td>Landscape and vegetation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Minimum topsoil depths</td>
<td>- 150 mm for turf species</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 300 mm for ground covers and small shrubs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 450 mm for large shrubs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- 600 mm for trees</td>
<td></td>
</tr>
</tbody>
</table>

6 MEASUREMENT AND PAYMENT

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 channel (gutter).
Excavation and stone pitching of open drains: To 1121 Open drains, including kerb and channel (gutter).
Miscellaneous minor concrete work: To 0319 Minor concrete works.

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>1351.1 Excavation and backfilling for stormwater drainage culverts and</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</td>
</tr>
<tr>
<td>structures.</td>
<td>Box culverts:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Plan area calculated from</td>
<td></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>base slab dimensions plus 300 mm and wingwalls as shown on the drawings. - Depth is average actual site measurement from the bottom of the specified bedding to the ground surface after stripping topsoil. <strong>Other drainage structures:</strong> - Plan area from outside dimensions as shown on the Drawings. - Depth is average actual site measurement from the bottom of the specified bedding to the ground surface after stripping topsoil. <strong>Unsuitable material under culverts and drainage structures:</strong> - Actual plan area and average depth below bedding of material removed.</td>
<td>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>
<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>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, traffic control, erosion control.</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 A

Schedule of excavation dimension for **PAY ITEM 1351.2**.

**Excavation for reinforced concrete and fibre reinforced cement pipes**

#### Positive projection (if excavation required)

<table>
<thead>
<tr>
<th></th>
<th>Single cell</th>
<th>Multi cell</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td></td>
<td>Sum of external diameters + sum of spacings between pipes measured square to the line of the culvert + 1 m.</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>In natural ground</td>
<td>Average actual depth from topsoil stripped ground surface to underside of specified bedding.</td>
</tr>
<tr>
<td></td>
<td>In embankment</td>
<td>Average actual depth or 500 mm above top of pipe to underside of specified bedding, whichever is lesser.</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td>Actual excavation length, centre to centre of pits or centre of pit to face of headwall.</td>
</tr>
</tbody>
</table>

#### Wide trench

<table>
<thead>
<tr>
<th></th>
<th>Single cell:</th>
<th>External pipe diameter + 1 m.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td>Multi cell:</td>
<td>Sum of external diameters + sum of spacings between pipes measured square to the line of the culvert + 1 m.</td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>In natural ground</td>
<td>Average actual depth from topsoil stripped ground surface to underside of specified bedding.</td>
</tr>
<tr>
<td></td>
<td>In embankment</td>
<td>Maximum 500 mm above top of pipe to underside of specified bedding.</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td>Actual excavation length, centre to centre of pits or centre of pit to face of headwall.</td>
</tr>
</tbody>
</table>

#### Normal trench

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>1.4 x external pipe diameter or + 300 mm on each side, whichever is the greater.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Width</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Depth</strong></td>
<td>In natural ground</td>
<td>Average actual depth from topsoil stripped ground surface to underside of specified bedding.</td>
</tr>
<tr>
<td></td>
<td>In embankment</td>
<td>Maximum 500 mm above top of pipe to underside of specified bedding.</td>
</tr>
<tr>
<td><strong>Length</strong></td>
<td></td>
<td>Actual excavation length, centre to centre of pits or centre of pit to face of headwall.</td>
</tr>
</tbody>
</table>

#### Steel pipes and pipe arches

<table>
<thead>
<tr>
<th></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>------------------------</td>
<td>---------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Depth</td>
<td></td>
<td>As for RC and FRC pipes.</td>
</tr>
</tbody>
</table>

**Flexible pipes**

<table>
<thead>
<tr>
<th>Width</th>
<th>for pipes of:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ext dia at collar</td>
<td>External diameter of pipe + 200 mm ≥ 75 ≤ 150.</td>
</tr>
<tr>
<td></td>
<td>Ext dia at collar</td>
<td>External diameter of pipe + 300 mm ≥ 150 ≤ 300.</td>
</tr>
<tr>
<td></td>
<td>Ext dia at collar</td>
<td>External diameter of pipe + 400 mm ≥ 300 ≤ 450.</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: [complete/delete]
Selections: As documented.
Design
Designer: [complete/delete]
Design life of pipe drainage system: [complete/delete]
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following:
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1112 Earthworks (Roadways).
- 1171 Subsurface drainage.
- 1351 Stormwater drainage (Construction).
- 1354 Drainage structures.
- 1392 Trenchless conduit installations.

1.3 REFERENCED DOCUMENTS

Standards
General: The following documents are incorporated into this worksection by reference:
AS/NZS 1260:2009 PVC-U pipes and fittings for drain, waste and vent application
AS/NZS 1477:2006 PVC pipes and fittings for pressure applications
AS 1646-2007 Elastomeric seals for waterworks purposes
AS/NZS 2041 Buried corrugated metal structures
AS/NZS 2041.1:2011 Design methods
AS/NZS 2041.4:2010 Helically formed sinusoidal pipes
AS/NZS 2041.6:2011 Bolted plate structures
AS/NZS 2566 Buried flexible pipelines
AS/NZS 2566.1:1998 Structural design
AS/NZS 2566.2:2002 Installation
AS 2758 Aggregates and rock for engineering purposes
AS 2758.1-1998 Concrete aggregates
AS/NZS 4058:2007 Precast concrete pipes (pressure and non-pressure)
AS/NZS 4130:2009 Polyethylene (PE)pipes for pressure applications
AS 4139-2003 Fibre reinforced concrete pipes and fittings
AS/NZS 5065:2005 Polyethylene and polypropylene pipes and fittings for drainage and sewerage applications
AASHTO M190-2008 Standard specification for bituminous coated corrugated metal culvert pipe and pipe arches
AASHTO M196-2004 Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
AASHTO M197-2006  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
POP001-2011  Electrofusion jointing of PE pipe and fittings for pressure applications
POP003-2011  Butt fusion jointing of PE pipes and fittings – recommended parameters
POP102-2009  Solvent cement jointing of PVC pipe

1.4 INTERPRETATIONS

Abbreviations
General: For the purposes of this worksection the abbreviations given below apply.
- FRC: Fibre-reinforced concrete.
- 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.

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent's 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.
Calculations: [complete/delete]
Work-as-executed drawings: [complete/delete]
- Components: Pipes and fittings.
- Samples: Pretreat the samples if necessary so as to represent the condition and grading when compacted and in service.
Design: [complete/delete]
Drawings: [complete/delete]
- Execution details: Refer to HOLD POINTS.
Manuels: [complete/delete]
Prototypes: [complete/delete]
Technical data: [complete/delete]
Type tests: [complete/delete]
Warranties: [complete/delete]

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>MATERIALS</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>Principal Certifying Authority</td>
</tr>
<tr>
<td>Corrugated aluminium pipes</td>
<td></td>
<td></td>
<td></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>
<td>----------------------</td>
<td>------------</td>
</tr>
<tr>
<td><strong>General</strong> - Durability</td>
<td>Submit for approval the protective treatment to achieve the expected design life</td>
<td>1 week before application</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Plastic Flexible pipes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>General</strong> - Proprietary product</td>
<td>Submit for approval prior to construction</td>
<td>2 weeks</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>

### EXECUTION

**Installation**

**General** - Progressive inspections

Give notice for completed installation and jointed pipes for inspection

Progressive before backfilling

Principal Certifying Authority

### 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 units</td>
<td>1 week</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>
</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

[www.concpipe.asn.au](http://www.concpipe.asn.au) **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.

Pipe jacking: [complete/delete]

- 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.

Fibre reinforced concrete pipes
Requirement: Provide fibre reinforced concrete pipes to AS 4139 and in conformance with the following:

Strength requirement: [complete/delete]
- Pipe sizes: As shown on the drawings.
- Load classes and installation conditions: As shown on the drawings.
- Jointing: Provide flexible, elastomeric, double V-ring joints to AS 1646. Use flush or butt joints only for the first pipe when extending existing pipes.
- Tests required: Dimensions and tolerance test to verify conformance with AS 4139 clause 10.
  Test frequency: One pipe per 50 pipes.
Aggregates: To AS 2758.1 and the following:
[complete/delete]
Manufacturer’s statement: Submit manufacturer’s statement of information to AS 4139 Appendix A2.
Marking: To AS 4139 clause 12.
Durability.
Durability: Protective treatments to AS 4139 Appendix B and the manufacturer’s recommendations.
Protective treatment: [complete/delete]

3.3 CORRUGATED STEEL PIPES

3.4 CORRUGATED ALUMINIUM PIPES
General
Requirement: Provide corrugated aluminium pipes to AASHTO M197-06 and AASHTO M196-08, AS/NZS 2041.4 and in conformance with the following:
- Type:
  - Staked, double offset lock seam joint.
- Thickness:
  - 2.0 mm for 450 mm diameter and under.
  - 2.5 mm for 600 mm to 1500 mm diameter.
  - 3.0 mm for 1650 mm to 2400 mm diameter.
- Corrugations:
  - 68 x 13 mm for 1500 mm diameter and under.
  - 125 x 25 mm for 1650 mm to 2400 mm diameter.
Dissimilar metals: Prevent dissimilar metals from direct contact.
Durability: Submit for approval the protective treatment required to achieve the required design life to the manufacturer’s recommendations. This is a HOLD POINT.

3.5 PLASTIC FLEXIBLE PIPES

http://www.pipa.com.au
General
Requirement: Provide flexible pipes including fitting to AS/NZS 2566.1 with pipe class and size as shown on the drawings.
Pressure polyethylene (PE): To AS/NZS 4130.
Polyethylene (PE) and Polypropylene (PP): To AS/NZS 5065.
PVC pipes: To AS/NZS 1260.
Pressure PVC: To AS/NZS 1477.
Proprietary product: Submit proprietary product for approval prior to construction. This is a HOLD POINT.
Plastic flexible pipes: [complete/delete]

Store rubber rings for pipe joints: To AS 1646.
Electrofusion jointing for PE pressure pipe: Conform to POP001.
Butt fusion jointing for PE pipe: Conform to POP003.
Solvent cement jointing for PVC pipe: Conform to POP102.

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 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 trenchstops 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 concrete 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**.

**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><strong>MATERIALS</strong></td>
<td></td>
<td></td>
</tr>
<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: Test frequency:</td>
<td>One pipe per 50 pipes.</td>
<td></td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Culverts:</td>
<td></td>
<td></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>68 mm pitch</td>
<td>Joints for steel pipes</td>
</tr>
<tr>
<td>Geotextile cover material:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Width</td>
<td>250 mm</td>
<td></td>
</tr>
</tbody>
</table>
### Activity Limits/Tolerances Worksection clause Reference

- Minimum mass 270 grams/m²  
Invert protection sprayed concrete  
- Over crest of corrugations over bottom third of pipe circumference > 100 mm  
Sprayed concrete reinforcement:  
- Reinforcement Steel wire 4 mm diameter with 200 mm square mesh  
- Laps in fabric 300 mm  
- Cover 50 mm

### 5 MEASUREMENT AND PAYMENT

#### 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>
</table>
| 1352.1 Supply and install pipe drainage culverts, pipes, structures. | Linear m of pipe drainage culvert:  
- Measured on centreline of each type, class and size of stormwater drainage pipe culvert.  
- The plan length between centres of gully pits or faces of headwalls. | 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:  
- Supply.  
- Survey and setting out.  
- Bedding.  
- Jointing (including connections).  
- Subsoil drains at pits and headwalls.  
- Temporary bracing and strutting.  
- Anchoring system including anchor blocks.  
- Bituminous painting.  
- Sprayed concrete lining 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>- 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: [complete/delete]

Design
Designer: [complete/delete]
Design life of culvert: [complete/delete]
Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- 0136 General requirements (Construction)
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1112 Earthworks (Roadways).
- 1121 Open drains, including kerb and channel (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:
AS 1012 Methods of testing concrete
AS 1012.9-1999 Determination of the compressive strength of concrete specimens
AS 1379-2007 Specification and supply of concrete
AS 1478 Chemical admixtures for concrete, mortar and grout
AS 1478.1-2000 Admixtures for concrete
AS/NZS 1554 Structural steel welding
AS/NZS 1554.3:2008 Welding of reinforcing steel
AS 1597 Precast reinforced concrete box culverts
AS 1597.1-2010 Small culverts (not exceeding 1200 mm span and 1200 mm height)
AS 1597.2-1996 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 2758.1-1998 Concrete aggregates
AS 3600-2009 Concrete structures
AS 3610 Formwork for concrete
AS 3972-2010 General purpose and blended cements
AS/NZS 4671:2001 Steel reinforcing materials
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.

1.6 SUBMISSIONS

Approval
Submissions: To the Superintendent's approval.
Calculations: [complete/delete]
Components: [complete/delete]
Design: [complete/delete]
Drawings: [complete/delete]
Execution details: [complete/delete]
Manuals: [complete/delete]
Materials: [complete/delete]
Prototypes: [complete/delete]
Samples: [complete/delete]
Technical data: [complete/delete]
Type tests: [complete/delete]
Warranties: [complete/delete]

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/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>Precast concrete</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General - Certificate</td>
<td>Submit certificate of conformance</td>
<td>3 working days prior to dispatch</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td>Testing - Prototype load testing</td>
<td>Submit certificate and test results</td>
<td>3 working days prior to dispatch</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>EXECUTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coffer dams</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction of</td>
<td>Submit construction</td>
<td>1 week prior to</td>
<td>Principal Certifying Authority</td>
</tr>
</tbody>
</table>
## Handling, delivery and storage

**General - Inspection**
- **Inspect box culvert units for conformance**
  - **Notice for inspection:** 1 week prior to installation
  - **Release by:** Principal Certifying Authority

**Establishment**
- **Pegging of culverts**
  - **Present set out of centreline and inverts**
  - **Notice for inspection:** 3 working days
  - **Release by:** Principal Certifying Authority

**Foundations**
- **Bedding**
  - **Select from bedding alternatives**
  - **Notice for inspection:** 1 week before placing material
  - **Release by:** Principal Certifying Authority

**Installation**
- **Inspection of seals**
  - **Present joints and seals for before backfilling**
  - **Notice for inspection:** 1 working day
  - **Release by:** Principal Certifying Authority

### Completion

**Construction loading on culvert - Constraint**
- **Do not load base slab until strength has reached 32 MPa**
  - **Notice for inspection:** 28 days
  - **Release by:** Principal Certifying Authority

**Construction loading on culvert – Construction vehicles or plant**
- **Submit procedure for prevention of early loading**
  - **Notice for inspection:** 1 week prior to loading
  - **Release by:** Principal Certifying Authority

## MATERIALS

### Precast concrete

**Sampling and testing**
- **Provide test results**
  - **Notice for inspection:** 3 working days

## EXECUTION

### Coffer dams

**Timber or bracing removal**
- **Inspect removal of bracing materials**
  - **Notice for inspection:** 1 working day

### Establishment

**Diversion and disposal of water**
- **Submit water management plan for approval**
  - **Notice for inspection:** 1 week

### Cast in situ base slabs

- **Attainment of concrete minimum compressive strength**
  - **Notice for inspection:** 1 working day

## Backfill

### General - Wingwalls

- **Wait 21 days after concrete placement to commence backfill**
  - **Notice for inspection:** 21 days

### General – Balancing backfill

- **Control balanced backfill procedure**
  - **Notice for inspection:** 1 working day
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.
Aggregate properties: Conform to the Aggregate property schedule.

<table>
<thead>
<tr>
<th>Aggregate property</th>
<th>Tests</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water absorption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.

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.
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: [complete/delete]
For large culvert units to AS 1597.2: [complete/delete]
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: [complete/delete]
For large culvert units to AS 1597.2: [complete/delete]

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 dewatering of the construction area.
Costs: Allow for all costs associated with the construction of coffer dams and diversion and dewatering.

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.
- Large culvert unit: To AS 1597.2.
This is a HOLD POINT.

4.4 ESTABLISHMENT

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 channel (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 butt joints between the ends of units with cement mortar or grout of a consistency that ensures filling of the void.

Grout type: [complete/delete]
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: [complete/delete]
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 1172 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>(\leq 4200) mm</td>
<td></td>
</tr>
<tr>
<td>Small culvert unit:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Span</td>
<td>(\leq 1200) mm</td>
<td></td>
</tr>
<tr>
<td>- Height</td>
<td>(\leq 1200) mm</td>
<td></td>
</tr>
<tr>
<td>Water chloride ions</td>
<td>(\leq 500) mg/L</td>
<td>Constituent materials</td>
</tr>
<tr>
<td>Surface irregularities maximum</td>
<td>3 mm over the width of the surface</td>
<td>Formed concrete surface</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>
</tbody>
</table>

© NATSPEC
### Activity

<table>
<thead>
<tr>
<th>Limits/Tolerances</th>
<th>Worksection clause reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock excavation 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>Bedding for precast base slabs</td>
</tr>
<tr>
<td>- To line of underside of the base slab ± 5 mm</td>
<td></td>
</tr>
<tr>
<td>- To level of underside of the base slab ± 10 mm</td>
<td></td>
</tr>
<tr>
<td>- Compacted depth &gt; 150 mm.</td>
<td></td>
</tr>
<tr>
<td>Cast in situ base slabs:</td>
<td>Cast in situ base slabs</td>
</tr>
<tr>
<td>- Invert levels ± 10 mm</td>
<td></td>
</tr>
<tr>
<td>- Grade 5 mm in 2.5 m (1 in 500).</td>
<td></td>
</tr>
<tr>
<td>- Plan position ± 50 mm</td>
<td></td>
</tr>
<tr>
<td>- Surface irregularities: &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 20 MPa</td>
<td></td>
</tr>
<tr>
<td>Cement mortar:</td>
<td>Placement of units</td>
</tr>
<tr>
<td>- Water:cement:sand ratio by mass 0.4:1:3</td>
<td></td>
</tr>
<tr>
<td>- Thickness of mortar bed &gt; 5 mm</td>
<td></td>
</tr>
<tr>
<td>Gap between adjacent multi-cell culverts 15 mm</td>
<td>Placement of units</td>
</tr>
<tr>
<td>Protection of mortar joints &gt; 48 hours before backfill Placement of units</td>
<td></td>
</tr>
<tr>
<td>Depth of backfill in side zones 300 mm Backfill</td>
<td></td>
</tr>
<tr>
<td>Compaction layers &gt; 150 mm compacted thickness Backfill</td>
<td></td>
</tr>
<tr>
<td>Backfill against wingwalls ≥ 21 days after casting. Backfill</td>
<td></td>
</tr>
<tr>
<td>Backfill maximum level difference to avoid differential loading 600 mm Backfill</td>
<td></td>
</tr>
<tr>
<td>Horizontal terraces requiring cut benches at least 1 m width before the backfill is placed &gt; 4H:1V Backfill</td>
<td></td>
</tr>
<tr>
<td>Construction loading:</td>
<td>Completion</td>
</tr>
<tr>
<td>- Restriction on construction traffic after the casting of the base slab 28 days</td>
<td></td>
</tr>
<tr>
<td>- Compressive strength of the base slab concrete 32 MPa minimum</td>
<td></td>
</tr>
</tbody>
</table>

### 6 MEASUREMENT AND PAYMENT

#### 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 channel (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 fails 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><strong>1353.1 In situ base slab</strong></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><strong>1353.2 Precast concrete box culverts</strong></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: [complete/delete]

Design

Designer: [complete/delete]

Authority requirements: [complete/delete]

1.2 CROSS REFERENCES

General
Requirement: Conform to the following worksection(s):
- 0136 General requirements (Construction).
- 0152 Schedule of rates – supply projects.
- 0161 Quality (Construction).
- 0167 Integrated management.
- 0319 Minor concrete works.
- 1101 Control of traffic.
- 1102 Control of erosion and sedimentation.
- 1112 Earthworks (Roadways).
- 1121 Open drains, including kerb and channel (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 worksection by reference:

AS 1012-Various Methods of testing concrete
AS 1379-2007 Specification and supply of concrete
AS 1478 Chemical admixtures for concrete, mortar and grout
AS 1478.1-2000 Admixtures for concrete
AS/NZS 1554 Structural steel welding
AS/NZS 1554.3:2008 Welding of reinforcing steel
AS 1657-1992 Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 1726-1993 Geotechnical site investigations
AS 2758 Aggregates and rock for engineering purposes
AS 2758.1-1998 Concrete aggregates
AS 3600-2009 Concrete structures
AS 3610 Formwork for concrete
AS 3610.1-2010 Documentation and surface finish
AS 3735-2001 Concrete structures retaining liquids
AS 3972-2010 General purpose and blended cements
AS 3996-2006 Access covers and grates
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.

1.5 SUBMISSIONS

Approval
Submissions: To the Superintendent’s approval.
Calculations: [complete/delete]
Components: [complete/delete]
Design: [complete/delete]
Drawings: [complete/delete]
Execution details: [complete/delete]
Manuals: [complete/delete]
Materials: [complete/delete]
Prototypes: [complete/delete]
Samples: [complete/delete]
Technical data: [complete/delete]
Type tests: [complete/delete]
Warranties: [complete/delete]

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>Principal Certifying Authority</td>
</tr>
<tr>
<td>General – Quality</td>
<td>Submit quality test results.</td>
<td>3 working days before delivery</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Installation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Excavation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excavation and compaction of foundation as documented</td>
<td>1 working day</td>
<td>Principal Certifying Authority</td>
</tr>
<tr>
<td><strong>Headwalls and wingwalls</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>General – Rock</td>
<td>Submit details of cut-off</td>
<td>1 working day</td>
<td>Principal Certifying Authority</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.
Aggregate properties: Conform to the Aggregate property schedule.

<table>
<thead>
<tr>
<th>Aggregate property</th>
<th>Tests</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water absorption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particle size</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Durability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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: [complete/delete]

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: [complete/delete]
Concrete cover: To AS 3600.

Strength
Minimum compressive strength: [complete/delete]

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>A1</th>
<th>A2</th>
<th>A3</th>
<th>A4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover number</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Load class</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decorative edging</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cover type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Security</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cover orientation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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.
Mass 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: ≤ 600 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.

Precast headwalls: Cannot be used for pipes exceeding 525 mm diameter.

**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 weep hole.

Geotextile: Enclose the broken stone or river gravel with geotextile filter fabric in conformance with AGPT04G.
Alternative to geotextile: Cover the facial area of the structure with an equivalent area of geocomposite.

4.5 PITS AND JUNCTION BOXES

Precast units

General: Should not be used in pits and junction boxes unless approved by Council. Council will consider their use when the design of the pipe inlets is sufficiently straightforward to guarantee successful construction. Precast units may be used for access covers, gully grates and frames

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.

Kerb Deflectors

General: Should not be used at the entrance to a pit except where the grade exceeds 5%. Seek the advice of Council prior to design.

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

Summary of 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></td>
</tr>
<tr>
<td>- Surface irregularities</td>
<td>&lt; 3 mm over the width of the surface</td>
<td></td>
</tr>
<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>Inlet and outlet invert levels</td>
<td>± 10 mm</td>
<td></td>
</tr>
<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>
<td></td>
<td></td>
</tr>
<tr>
<td>- Thickness</td>
<td>10 mm</td>
<td></td>
</tr>
<tr>
<td>- Cement mortar</td>
<td>1:3 general purpose cement:sand</td>
<td></td>
</tr>
<tr>
<td>Wingwalls location</td>
<td>135° to the headwall</td>
<td></td>
</tr>
<tr>
<td>Step irons:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Distance from top of the uppermost rung to top of pit</td>
<td>&lt; 600 mm</td>
<td></td>
</tr>
<tr>
<td>- Distance of top of the bottom rung above the invert of the pit</td>
<td>≥ 300 mm and ≤ 500 mm</td>
<td></td>
</tr>
<tr>
<td>- Rung spacings</td>
<td>300 mm ± 50 mm</td>
<td></td>
</tr>
<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>
</tr>
<tr>
<td>- Height of gravel above the bottom of the weephole</td>
<td>&gt; 450 mm</td>
<td></td>
</tr>
<tr>
<td>- Plan area of gravel centrally about the weephole</td>
<td>&gt; 600 mm along the wall and 300 mm out from the wall</td>
<td></td>
</tr>
</tbody>
</table>
Concrete construction:

- Strength > 32 Mpa
- Aggregate size > 12 mm.
- Finished level ± 3 mm. level of the surrounding area
- Compressive strength > 15 MPa

Headwalls and wingwalls – cut off walls
- Depth into sound rock > 150 mm

Foundation for concrete bases
- Mass concrete bedding depth > 50 mm

6 MEASUREMENT AND PAYMENT

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>m³ 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, lids, 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>
</tr>
</tbody>
</table>

Alternatively use a single pay item.

<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 drainage structures other than pipes and box culverts.</td>
<td>‘Each’ completed structure as shown on the 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>
</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></td>
<td></td>
<td>structures including cast in metal work, precast items frames, grates, lintels, lids, backfilling.</td>
</tr>
</tbody>
</table>
1859 CCTV Inspection of Drainage Conduits

1 GENERAL

1.1 RESPONSIBILITIES

General: Provide CCTV inspection and reporting of stormwater drainage and sewerage conduits and related maintenance structures, as documented and in conformance with ANNEXURE - SCOPE OF CCTV INSPECTION.

1.2 CROSS REFERENCES

General

Requirement: Conform to the following:
- 0135 General requirements (Services).
- 0153 Schedules - period supply and service.
- 1101 Control of traffic.
- 1851 Clear open space and drains.
- 1852 Clear open space drainage culverts.
- 1853 Clear road reserve culverts and pits
- [complete/delete]

1.3 REFERENCED DOCUMENTS

Standards

General: The following document is incorporated into this worksection by reference:

Other publications
IPWEA - Institute of Public Works Engineering Australia
Practice Note 5 – 2011 Stormwater drainage
WSAA - Water Services Association of Australia
WSA 05 v3.1 – 2013 Conduit inspection reporting code of Australia

1.4 STANDARD

General
Code: To WSA 05.

1.5 INTERPRETATION

Abbreviations

General: For the purposes of this worksection the following abbreviations apply:
- ADAC: Asset Design As Constructed.
- CCTV: Closed Circuit Television.
- WHS: Work Health and Safety.

Definitions

General: For the purposes of this worksection the definitions given in WSA 05 apply.

1.6 SUBMISSIONS

Flow management plan

Requirement: Submit the FMP, in conformance with FLOW MANAGEMENT.
Submission time: A minimum of 5 working days before starting a CCTV inspection at any location.

Qualifications

Requirement: Submit evidence of operator’s qualifications, in conformance with OPERATOR TRAINING.
Submission time: A minimum of 5 working days before starting CCTV inspection at any location.

Report

Inspection results: Submit inspection reports, in conformance with Inspection report.
Submission time: A maximum of 5 working days from completion of the first CCTV inspection and a maximum of 10 working days for subsequent inspections. Urgent issues: Immediately after completion of the field investigation submit details of any defects nominated as requiring immediate notification, in conformance with Immediate notification. Provide the Principal with the option of a site visit whilst the camera is still on site. **Work health and safety plan** Requirement: Submit the WHS plan, in conformance with WHS plan. Submission time: A minimum of 2 working days before starting a CCTV inspection at any location.

2 PRE-INSPECTION PLANNING

2.1 DRAINAGE NETWORK

**Asset information**
General: For conduits and maintenance structures to be inspected the following information is provided:
- A plan/map of the network, to scale, including node and conduit locations, node numbers, street names and property boundaries.
- Size, material, class and flow direction of conduits.
- Coordinates, depth, surface and invert levels of nodes.
- Dates of construction - Age.
- Asset names or descriptors.
- Critical flow patterns and any pumped discharges.
- Any isolation or flow control measures relating to the network.

**Access**
Location: Confirm location of access maintenance structures based on the asset information obtained.
Traffic impact: Do not use access maintenance structures which are located under road surfacing or at heavy traffic junctions, if possible. Complete CCTV inspection from adjacent maintenance structures.
Notification: Provide minimum notice of 1 full working day of any required access locations which are inaccessible on Council property and a written notice to the owner/occupier before accessing any maintenance structures on private property, with the format and timeframe for such notice to be in conformance with relevant State legislation and local laws.
Identification: Always carry the Council/Municipality/Utility identification provided.

2.2 OPERATOR TRAINING

**Qualifications**
Requirement: Use operators trained and qualified with certified competence in conformance with WSA 05 clause 2.2.1 to conduct CCTV inspections, identify defects and report on condition of conduits and related maintenance structures. For stormwater assets the operators must also read the guidelines in IPWEA *Practice Note 5 – Stormwater drainage*.

2.3 CLEARING AND CLEANING

**General**
Requirement: If clearing or cleaning of the conduit and maintenance structures prior to inspection is requested, conform to 1851 Clear open space and drains, 1852 Clear open space drainage culverts or 1853 Clear road reserve culverts and pits as appropriate.

2.4 WORK HEALTH AND SAFETY

**WHS plan**
Requirement: Prepare a WHS plan for the CCTV inspection works including safe work method statements for each inspection location, in conformance with State regulatory requirements.

**Confined spaces**
General: Make sure all staff entering any confined space have completed the necessary confined space training, and are provided with the necessary safety equipment, required by State WHS regulation.
2.5 FLOW MANAGEMENT

General
Timing: Where possible, plan to carry out CCTV inspections during dry weather for stormwater conduits and during periods of predicted low flow for sewerage conduits.
FMP: If it is anticipated that flows within the conduit will require management for a successful CCTV inspection, prepare a FMP detailing how normal dry weather and wet weather flows will be managed.

Flow storage
Upstream: Where storage of flows within the network can be safely achieved upstream of the inspection location, detail the following in the FMP:
- Management resources.
- Monitoring procedures of upstream storage/flow levels.
- Procedures to manage any sudden rises in storage/flow levels.
- Systems in place to make sure that, where plugs are used, they cannot be displaced in a situation where they deflate.

Flow diversion
By-pass pumping: If storage of flows within the network cannot be safely achieved, use by-pass pumping to divert flows past the area of inspection. Detail how the by-pass pumping will be installed, managed and operated in the FMP and include the following information:
- Proposed pumping access points.
- Identification of each point of inflow into the conduit to be inspected.
- Proposed equipment and provision of back-up equipment.
- Procedures for monitoring the equipment in operation.
- Control of noise and public safety.
- Anticipated duration of pumping activities.
- Procedures for dealing with any spillage/leakage which may occur.
3 EQUIPMENT

3.1 CCTV CAMERA

General
Standard: To WSA 05 clause 2.5.1.
Camera type: Use a camera to suit the specific conduit diameter and required picture quality.

Capability and quality
Requirement: Use cameras which conform to the following:
- Capability (Manoeuvrability): To WSA 05 clause 2.5.2.
- Picture quality: To WSA 05 clause 2.5.3.

4 EXECUTION

4.1 PROVISION FOR TRAFFIC

General
Requirement: Conform to 1101 Control of traffic.

4.2 REQUIRED DOCUMENTATION

General
Requirement: The CCTV operator and inspection reporter/coder must have a copy of this specification and WSA 05 available at all times during inspection and coding.

4.3 CAMERA OPERATION

Camera position
Requirement: Position camera centrally within the conduit or maintenance structure in conformance with the tolerance requirements of WSA 05 clause 2.6.1.

Camera travel speed
Maximum: Maneuvre the camera at no greater than the maximum speed documented in WSA 05 clause 2.6.2.

Camera pan
Restriction: Do not pan the camera whilst the camera is moving. At a defect or feature, stop the forward camera movement and then pan or rotate the camera, to conform to WSA 05 clause 2.6.2.

4.4 INSPECTION PROCEDURE

General
Asset data: Confirm that the conduit material and size conforms to any asset data obtained before starting the inspection. Identify and record any asset data which contradicts previous asset data obtained.

Inspection
Maintenance structures: Inspect, observe and record any features or defects of the maintenance structures at the start and end of the inspection. Also include any intermediate maintenance structures, not previously documented in the obtained asset data.
Start of conduit: Position camera at the face of the maintenance structure (conduit invert) and inspect the start of the conduit. Rotate the camera through 360°, paying particular attention to the 3, 6, 9 and 12 o’clock positions for the start of any longitudinal cracks or fractures. Record start node and water level codes to WSA 05.
End of conduit: Complete the same 360° inspection at the end of the conduit length. Record an inspection closing code to WSA 05.
Conduit joints: When defects are visible upon approach to a joint, complete the same 360° inspection at those joints.

Observation
Record: Record observed features or defects, which extend over a length greater than 1 m, as a continuous code. Define the continuous code by recording the start and finish linear measurement of the defect from the longitudinal reference point. Record defects or observations affecting less than 1 m of the conduit length as a non-continuous defect.
Camera vision
Clean lens: If the lens of the camera becomes obscured, preventing a clear view of the conduit and potential defects, pause the inspection and clean the lens. If the camera needs to be removed to clean the lens, the inspection can be resumed at the location where the inspection was paused. The video however must be a single video record.

Completion
Covers: Correctly reinstate all maintenance structure covers at the completion of the field CCTV inspection.

4.5 LINEAR MEASUREMENT

General
Standard: To WSA 05 clause 2.7.
Levels: Record all levels to Australian Height Datum (AHD). If a reference level is not available, record relative levels from the centre of the cover to the maintenance structure at which the inspection is to start.

Longitudinal reference point
Zero measurement: Set the longitudinal reference point as the centre of the maintenance structure at which the inspection is to start. The start linear measurement is the distance from the centre of the maintenance structure to the face of the maintenance structure.
Finish point: Finish the inspection at the corresponding reference point in the target maintenance structure, unless inspection has to be abandoned.
Alternative: If the centre of the maintenance structure cannot be accurately determined, set the longitudinal reference point in conformance with WSA 05 clause 3.5.4.5.

4.6 MAXIMUM DEPTH OF FLOW

In-service assets
General: Pause or terminate any inspection if the maximum depth of flow values stated in WSA 05 Table 2.1 are exceeded. Conform to the requirements of WSA 05 clause 2.11.

4.7 RECORDING WATER LEVEL

General
Water level: Record the water level of stagnant (ponding) water or water flowing at a constant depth at the start of the inspection. Do not record water flowing at fluctuating depths as a water level. Record water level and changes in water level to WSA 05 clause 3.7.8.3, Quantification 1.
Sagging
Sag: Record the water level to WSA 05 clause 3.7.8.3, Quantification 1, where the water level is increasing due to a sagging conduit. Terminate the inspection if the camera becomes submerged, unless the camera will become unsubmerged in a short distance.

5 REPORTING

5.1 GENERAL

Inspection report
Requirement: Prepare a report of the CCTV inspection in conformance with WSA 05 clause 2.12.1, WSA 05 Appendix A and as follows:
- Report file type: [complete/delete]
- Report format: [complete/delete]
- Photographs of features/defects: [complete/delete]
- Still image file type: [complete/delete]
- Still image format: [complete/delete]
- Video clips of features/defects: [complete/delete]

Video record
Data display: During video playback, display data, superimposed on the image, to satisfy the requirements of WSA 05 clause 2.8. For conduits also include the following data:
- Direction of view (a dial, mimic or graphical indicator showing the camera’s position with respect to the angle/circumferential direction of view). If camera does not have capability to
record the direction of view, record the angle of view in conformance with WSA 05 clause 3.7.9.4.

- Conduit asset reference number.

Video file type: [complete/delete]

Video format: [complete/delete]

Drawings
Requirement: Provide electronic format drawings, included in the inspection report, conforming to the ADAC methodology.

5.2 OBSERVATION CODING

Conduit inspection
Reporting: When describing and encoding all observations from the CCTV inspection, conform to the requirements and codes in WSA 05 Section 3.

Header information: Record the mandatory information required by WSA 05 clause 3.4.2.

Optional information: [complete/delete]

Maintenance structure inspection
Reporting: When describing and encoding all observations from the CCTV inspection, conform to the requirements and codes in WSA 05 Section 4.

Header information: Record the mandatory information required by WSA 05 clause 4.4.2.

Optional information: [complete/delete]

Immediate notification
Requirement: Upon completion of the field investigation, immediately notify the Principal of any observed defect that may warrant immediate investigation by the Principal, or if any of the following defect codes were observed:

- [complete/delete]

Scoring of defects
General: Score each defect and grade the apparent condition of the asset, in conformance with the relevant WSA 05 Appendices, as follows:

- Appendix C – Sewers.
- Appendix D – Stormwater.
- Appendix E – Maintenance structures.
ANNEXURE - SCOPE OF CCTV INSPECTION

Inspection location:

- Area: 

- Start: 

- End: 

Reason for inspection and scope of works: 

Inspection exclusions

The following defects/features can be excluded from the CCTV inspection reporting:

- [complete/delete]

Existing asset information

Data on existing assets has been made available to Contractors in conformance with WSA 05 clause 2.3, clause 3.4.4 and clause 4.4.4:

Yes [ ] No [ ] (see below)

The following asset data is not available:

Pre-cleaning/Obstruction removal

Before starting the CCTV inspection the Principal requires the following:

- [complete/delete]